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THE INFLUENCE OF HYPERTHYROIDISM UPON THE SECRETION OF FREE HYDROCHLORIC ACID

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The realization of the fact that certain glands within the body produce secretions which pass directly into the blood-stream has given rise to a multitude of investigations to determine the influence these secretions have either upon the body as a whole or upon the integral parts of the body. During the past decade, a voluminous literature has accumulated on the subject without any very definite solution of the major problem; but many interesting and valuable points have been determined. The clinical pictures that accompany hyper- and hypo- function of each of these glands have been studied with extreme thoroughness, but the determination that these pictures are by no means clear-cut has led to a great amount of confusion as to exactly what part the glands of internal secretion play in body metabolism. As is well known, these glands are very closely interrelated in their activities and this accounts for much of the difference of opinion. It is almost impossible to study the effects produced on the body as a whole by the secretion of one of these organs without considering the others. Yet dysfunction of one of these glands alone is known to produce certain clinical manifestations with some degree of constancy and it is the object of this paper to report a series of observations made in patients suffering from altered thyroid function with special reference to the influence exerted through the autonomic nervous system upon the secretion of hydrochloric acid in the stomach and endeavor to correlate this with the other symptoms of hyperthyroidism.

That the thyroid gland produces its effects on the body through its secretion, the so-called thyroxin, is assumed. Its action is chiefly concerned with the metabolism of the body cells. The effect that an over-amount of this hormone may have on the different organs of the body has been studied quite extensively though the manner in which it acts has been a matter of much controversy. Recent reports to the effect that dysfunction of the thyroid gland may alter gastric secretion have opened up another field for investigation. A review of the literature, however, shows that it is a matter of some dispute whether it is hyperthyroidism or hypothyroidism that raises or lowers the gastric secretion so far as the presence of hydrochloric acid is concerned.

The influence of thyroid dysfunction upon the production of hydrochloric acid.—In a study of five cases of myxœdema in which gastric analyses were

made, Sturgis[1] reports an achylia gastrica in three cases, a low acidity in one, and normal acidity in the fifth case. Lockwood's[2] results show an achlorhydria in six of the ten cases which he reported. Stone[3] found a persistent achlorhydria to exist in four, or twenty-five per cent., of the sixteen cases of myxœdema in which the gastric contents were examined. The results of clinical and experimental investigations that have been reported by other observers, however, make it a bit difficult to explain these findings. Katz,[4] for example, cured several cases of hyperacidity found in patients with myxœdema by the administration of thyroid extract. Hardt[5] noted a depression of both gastric secretion and acidity in patients who were given thyroid extract. Schnabel[6] reports cases of achylia gastrica made worse by treatment with thyroid extract. Levy[7] examined ten cases in which the basal metabolic rate varied from a minus 13 per cent. to a minus 25 per cent. Nine of these showed a definite hyperacidity and only one showed achlorhydria. In two of the cases with hyperacidity, thyroid extract medication resulted in a reduction of hydrochloric acid. Boenheim,[8] Rogers,[9] and Truesdale[10] carried on experiments in thyroid feeding on dogs with conflicting results, and it is difficult to determine from their findings the effect thyroid feeding has on gastric secretion since their analyses were carried out over too short a period. Moreover, they estimated only the volume of the secretion and the total acidity, not the free hydrochloric acid. Hardt[5] fed ten grams of desiccated thyroid gland to two dogs daily for two weeks. Gastric analyses were then made, the collection of the samples being started one hour before test-meals and completed one hour after feeding. As the result of his experiments he reports no indication of either hyperacidity or hypersecretion following the administration of the thyroid extract. In both dogs, on the contrary, there was a tendency toward depression of the acidity and rate of secretion. The acidity returned to normal a few days after the thyroid feeding was discontinued. Moll and Flint[11] repeated these experiments on four dogs with Janeway fistulæ. Fractional analyses were carried out over a period of five hours. In two cases thyroid feeding produced almost complete achlorhydria. In the third dog subacidity was noted but in the fourth animal there was a slight rise in acidity. Following up these experiments Chang and Sloan[12] (working under Carlson), found that thyroid feeding was capable of decreasing gastric secretion both in amount and percentage of hydrochloric acid. They found also that thyroidectomy in dogs resulted in a decided increase in the volume of the gastric juice and a less marked but demonstrable increase in acidity. Thyroid feeding subsequent to the thyroidectomy was capable of again depressing gastric secretion which came back to its previous level when the thyroid feeding was stopped. The mass of experimental evidence, therefore, would lead to the conclusion that hypothyroidism produces increased acidity whereas hyperthyroidism causes a decrease in gastric acidity.

The above findings, which appear to be contradictory, may possibly be explained as follows: myxœdema is often an end-result of hyperthyroidism and represents nature's sure cure of the condition. The oversecreting gland finally wears itself out and instead of secreting too much hormone secretes too little or none at all and a condition of athyroidism or myxœdema results. If this is the case a condition of hypoacidity or achlorhydria initiated by the preliminary hyperthyroidism would probably persist because of the inability of the acid-secreting cells to reëstablish their function after an inhibitory

stimulus of long duration had been removed. The animal experiments, however, being carried out on glands that were practically normal, would tend to show that an increased amount of thyroid hormone tended to cause hypoacidity. Further experimentation will be necessary before the meaning of these observations can be definitely determined.

Neilson[13] makes the statement that hyperacidity is frequent in hyperthyroidism and Boenheim[8] is of the same opinion. Maranon[14] has observed crises of hyperacidity. Sajous[15] states that excessive thyroid secretion causes increased metabolism in the gastro-intestinal mucous membrane and muscles, manifested by hyperchlorhydria, gastro-succorrhœa, frequent vomiting, diarrhœa, and serous light-colored stools. These findings are again contradicted by King[16] who reports achlorhydria to be present in cases of exophthalmic goitre despite an increased stomach and intestinal motility. Barker[17] states that there are certain cases of exophthalmic goitre in which the gastric secretion is increased, though, as a rule, it is diminished. Wolpe[18] found achylia gastrica to be constant in all definite cases of exophthalmic goitre, but in other types of hyperthyroidism the hydrochloric acid was unchanged. Leist[19] found achlorhydria present in seven out of eight cases of exophthamic goitre and explained his findings on the basis of a subnormal protein content of the blood-stream rather than upon hormone action.

Lockwood,[2] in a study of ninety cases of definite hyperthyroidism, made gastric analyses in twenty-four cases which presented digestive disturbances. In ten of these there was an achlorhydria present; three showed hypochlorhydria and eleven showed normal acidity. As a result of these studies he concluded that achlorhydria was present more often in severe cases and that it was more frequent in cases of exophthalmic goitre than in the forme fruste and in the adenomatous types.

H. Moll[11] made a study of fifty cases of hyperthyroidism. He divided his cases into five groups as follows:

	Achlorhydria	Hypochlorhydria	Normal	High N.
Chronic Graves' disease of more than two years' standing	15	6	1	1
Acute Graves' disease of less than one year's standing	4	4	3	–
Toxic adenoma	–	4	2	1
Forme fruste	3	–	2	1
Puberty hyperplasia	–	1	1	1
Totals	22	15	9	4

The conclusions he drew from these findings were: (1) that there is a constant tendency toward subnormal or absent secretion of hydrochloric acid in Graves' disease; (2) that the achlorhydria is more frequently found in cases of long standing, while in the more acute cases the gastric secretion is least diminished; (3) that the secretion of hydrochloric acid in cases of toxic adenoma and puberty hyperplasia is usually normal or subnormal, but that acid is never absent.

Gastric Analyses in Hyperthyroidism.—Twenty patients showing symptoms of hyperthyroidism have been studied with special reference to changes in the secretion of free hydrochloric acid. Analyses were made by the

TABLE I

Series of Twenty Cases

	Achlorhydria	Hypochlorhydria	Normal	Hyperchlorhydria
Hyperthyroidism more than two years	4	1	2	0
Hyperthyroidism one to two years	3	3	1	0
Hyperthroidism less than one year	4	1	1	0
Totals	11	5	4	0

fractional method over a period of two hours in all but three of these cases. In these the Ewald method was used. The results show that in this series eleven patients were found to have achlorhydria; five presented a hypochlorhydria and only four a normal acidity. In no instance was hyperchlorhydria present.

Table I shows the results in this series of cases classified according to the length of time that hyperthyroidism had been present. In this table no effort is made to classify the type of hyperthyroidism or whether eye symptoms were or were not present. The results seem to show very little except that possibly in the cases of short standing, less than one year, a larger percentage of cases shows a complete achorhydria than when the disease had been present for a longer period. Whether this can be interpreted as meaning that the early action of the altered thyroid secretion upon the sympathetic nervous system is to inhibit completely the secretion of acid temporarily and permit the ability to secrete acid to be regained subsequently as the sympathetic nervous system recovers from the attack or becomes unaffected by the stimulation of the thyroid secretion is a question which can be settled only by the examination of a much larger series of cases.

TABLE II

	Achlorhydria	Hypochlorhydria	Normal	Hyperchlorhydria
Exophthalmospresent	7	1	4	0
Exophthalmos absent	4	4	0	0
Totals	11	5	4	0

In Table II the cases are classified as to whether exophthalmos was or was not present. In the cases in which exophthalmos was present a larger percentage shows achlorhydria but also a larger percentage shows a normal

TABLE III

	Achlorhydria	Hypochlorhydria	Normal	Hyperchlorhydria
No fibrillation	8	4	3	0
Temporary fibrillation	2	0	0	0
Fibrillation fixed and remaining after operation	1	1	1	0
Totals	11	5	4	0

acidity. In other words, when exophthalmos is present there is apt to be either achlorhydria or a normal acid finding. In cases in which exophthalmos is absent there is found either achlorhydria or diminished acid secretion with no cases in which normal acidity is present.

In Table III the cases are classified as to whether or not fibrillation of the heart was present and if present whether it was: (1) temporary fibrillation which either disappeared under the use of Lugol's solution before operation or disappeared after operation; or (2) fixed fibrillation which was present at all times before operation and has persisted unchanged following operation. In the series in which fibrillation was not present the percentage of achlorhydria is about the same as in the other groups. When the fibrillation was temporary there were two cases of achlorhydria with no cases of diminished acid and none of normal acid. With fixed fibrillation remaining after operation there was one case in each group. The results in this table are interesting in that they appear to bear out the suggestion made previously that in the early cases of hyperthyroidism which are usually acute cases the secretion of hydrochloric acid is apt to be entirely absent or is markedly diminished. Temporary fibrillation occurs in the most acute cases of hyperthyroidism. It disappears under the exhibition of Lugol's solution and disappears immediately or shortly after operation. In this type of cases of temporary fibrillation, of which there are two in this series, there was achlorhydria in both with no cases presenting any diminution of acid or normal acid. In the cases of fixed fibrillation which are cases of long standing, there is one case in each group; one of these I have had the opportunity of examining some two years after operation and the patient still shows a complete absence of free hydrochloric acid.

This series of cases adds additional proof to the reports already on record, that an increased thyroid secretion diminishes the secretion of hydrochloric acid in the stomach. The mechanism by which the excess of thyroxin inhibits the secretion of acid has not been described, and an attempt at an explanation of this mechanism must necessarily include, first, a study of the manner in which thyroxin exerts its effects on the body as a whole.

A point particularly emphasized by Crile[20] and observed by clinicians is, that a condition of hyperthyroidism is usually accompanied by emotional excitement. That the production of emotional excitement is a function of the sympathetic nervous system has been shown by Cannon.[21] It is entirely likely then that the thyroid secretion acts by stimulating the sympathetic nervous system, and experimental studies add proof to this supposition.

The close relationship that exists between the glands of internal secretion and the vegetative nervous system may, as Pottinger[22] has shown, be inferred from their developmental history.

He says, "Primitive forms of life are without nervous systems, and whatever response to stimuli and whatever correlation of action takes place in them does so through chemical action. Later in the stages of evolution, as the organism becomes more complex, a more accurate and more rapid coör-

dination is required. For this, in addition to the chemical control, a nervous system is developed. In the higher forms of life, then, we have this double reciprocal control of all involuntary or vegetative functions. Stimulation of the glands of internal secretion takes place through the vegetative nerves, and the hormones produced by the glands in turn stimulate vegetative nerve structures." Langdon Brown,[23] in discussing the relationship between the adrenals, thyroid, and pituitary, on the one hand, and the sympathetic nervous system, on the other, says: "This association is reciprocal—as not only does the sympathetic nervous system stimulate the secretion of these ductless glands, but their secretion increases, in turn, the sympathetic response."

A study of the pharmacological action of the endocrines brings out the fact that while they all act more or less on the nervous systems of the vegetative life, certain ones have a predilection for action on one part of one system. For example, the internal secretions of the thyroid and pituitary are found to act particularly as stimulants of the true sympathetic (thoracico-lumbar autonomic) system, but they act only on certain portions of this system, the pituitary acting primarily on the vasomotors and the parts under control of the inferior mesenteric ganglion, while the thyroid secretions stimulate the superior portions of this system (cervical and thoracic portions).

Clinical observations show that a condition of hyperthyroidism resembles sympatheticotonia (manifested by rapid heart, high blood-pressure, emotionability, heat waves, slow digestion, dermographism, goose flesh and febrile reaction), in contrast to vagotonia, the principal signs of which are narrow pupils, tendency to bradycardia, hypotension, respiratory arhythmia, palpitation and extrasystoles, eructation, ærophagia and gastro-intestinal hypersecretion.

The thyroid secretion is then apparently sympathicotropic in its action, and, as Oswald, Cannon and Levy[24] have suggested, has the property of sensitizing the sympathetics. Goetsch,[25] working on this theory and the fact that epinephrin selectively stimulates the sympathetic system, injected 0.5 cubic centimetre of 1/1000 epinephrin into patients with known exophthalmic goitre and dogs rendered experimentally hyperthyroid by feeding desiccated thyroid. As a result of his experiments, he concluded that an oversecretion of thyroxin makes the sympathetic nerve cells respond more quickly to the stimulus of the epinephrin than is normally the case. B. Chamberlain,[26] however, was unable to confirm these results.

For further evidence that an oversecretion of the thyroid gland maintains the thoracico-lumbar autonomica in a state of hyperexcitability, I have studied the effect of paravertebral cervical anæsthesia on the heart rate of hyperthyroid patients and have found that as soon as the overstimulation of the cardiac muscle is released by paralysis of its sympathetic innervation, the parasympathetic (vagus) control is able to exert its moderator effect and the heart is slowed.[36]

Since the thyroid exerts its effect on the heart through the sympathetic system, it would naturally exert its effect on gastric secretion in the same way. That gastric secretion is regulated in part by nervous influence has long been

known, but only recently has there been any knowledge of the effects of the various components of the gastric nerve supply on secretory activity.

According to Bickel,[27] the chief and parietal cells in the fundus are innervated by both parasympathetic and sympathetic fibres, which excite, and sympathetic fibres, which inhibit secretory activity. The secretion of water and hydrochloric acid is brought about chiefly by the parasympathetic (vagus) nerve fibres and to a much lesser extent by the sympathetic fibres. The sympathetic secretory fibres, however, exert the major influence in the secretion of enzymes, while the parasympathetic fibres play but a secondary rôle in this function. The sympathetic inhibitory fibres inhibit all secretory activity. Bickel states further that excitation and inhibition of gastric secretion is always mediated through the extrinsic nerves.

Carlson[28] refers to the use of drugs which affect the vegetative nervous system as a means of showing the relative rôle played by the sympathetics and parasympathetics in the stimulation and inhibition of gastric secretion. He refers to Ehrmann[29] and Skaller,[30] who found that pilocarpine and nicotine stimulate gastric secretion, and also to Keetah, Luckhardt and Koch[31] who found that atropine depresses the secretion. Hess and Gundlach[32] and Pal[33] show that atropine completely inhibits the secretion from food stimulation while it decreases but does not completely inhibit the secretion after stimulation by histamine and gastrines. According to de Vecchi,[34] who cited the experimental work of Foa, section of the sympathetic nerves in animals was followed by a marked increase, and section of the parasympathetics by a marked diminution in the quantity of hydrochloric acid secreted in the stomach. In addition, he reported two clinical cases in which resection of the vagus branches along the lesser curvature of the stomach was followed by a diminution in acid secretion, which was still appreciable after one and a half years.

Under normal physiological conditions, the secretory activity of the fundic glands usually ceases while the stomach is empty. This inhibition of the fundic glands, according to Bickel,[27] probably is due to inhibitory impulses of central nervous origin conveyed by sympathetic fibres to the fundus. With regard to the mechanism of gastric secretion Kuntz[35] states that: "When food is taken into the mouth, the stimulation of the sense organs involved and the accompanying psycho-physiological processes initiate strong reflex parasympathetic excitation, in the presence of which the central inhibitory influences, acting on the fundic glands, gradually subside, and these glands are thrown into secretory activity. As the food enters the stomach, it stimulates the gastric mucosa directly, first in the fundus, then in the pyloric region, and somewhat later in the duodenum, giving rise to afferent impulses which are conveyed by the general visceral afferents to the appropriate centers in the central nervous system. These, in turn, give rise to both secretory and inhibitory impulses which are conveyed back to the glands by general visceral efferent fibres. As the process of digestion progresses, the secretine produced by the active mucosa and the secretine-like substances contained in the food reach the intestine and, being absorbed, are added to the secretine already present in the blood. This, in turn, exerts an influence on the secretory activity of the gastric glands. As the food passes into the intestine, and the stomach once more becomes empty, both the reflex and humoral excitation of the gastric glands subside and the central inhibitory impulses again gain the ascendency, and the fundic glands become quiescent."

It is my belief that in conditions of hyperthyroidism this whole gastric mechanism is deranged, and whether it may or may not be completely held in check depends upon the amount of stimulation exerted by the alteration in thyroid hormone upon that portion of the sympathetic system supplying the inhibitory action to the acid-secreting cells of the gastric mucosa. It has been shown that an excess of thyroid secretion overstimulates the sympathetic nervous system until it reaches a high level of sensitization. When such a state exists, the stimuli produced by the process of ingestion and digestion, which normally excite the parasympathetic system until it has the upper hand over the sympathetic, are incapable of bringing about the desired effect, namely, the secretion of hydrochloric acid. The sympathetics are maintained at too high a level of excitability to be overcome or surpassed by the physiological stimulation of the parasympathetics.

When the effect of sympathetic stimulation upon the gastric mechanism is compared with the effects of the same stimulation upon the cardiac mechanism, the result, namely, absence or diminution of free hydrochloric acid, is exactly what would be expected. In the cardiac mechanism the stimulation of the cervical sympathetic cord, especially the middle and inferior ganglia, overexcites the accelerator fibres of the cardiac mechanism and overrides the depressor or vagotonic fibres and tachycardia results, whereas, in the gastric mechanism, as has been seen, the same stimulation of the same group of nerve fibres, namely, the sympathetics, depresses gastric secretion and results in a diminution of the secretion of water and free hydrochloric acid.

These findings would tend to show that thyroid symptomatology should be interpreted rather in the light of the portion of the sympathetic system which receives the greatest brunt of the altered thyroid hormone rather than in any definite change in the hormone itself, and that types of thyroid diseases may be classified according to the portion of the sympathetic system most affected by the changed secretion of the thyroid. If the upper portion of the cervical sympathetic chain bears the greater brunt of the toxic effect of the thyroid secretion the result will show itself in eye changes; namely, the different forms of exophthalmos while the cardiac symptoms may be less promiment and be confined to tachycardia, and the gastric symptoms may be less marked and the secretion of hydrochloric acid diminished to a lesser extent or not at all. If, on the other hand, the middle and lower portions of the cervical sympathetic are principally affected, the major symptoms of the thyroid intoxication will show themselves in cardiac manifestations, and it is in this type of case that one would expect to encounter tachycardia going on to fibrillation which will at first be temporary and later become fixed, and in this type the gastric changes may be more marked than in the upper cervical type. The fact that in the early stages of hyperthyroidism the gastric secretion of acid is absent more frequently than when the condition has become more or less chronic may be explained by the fact that in the early stage of acute hyperthyroidism the entire sympathetic chain is affected, giving rise to a temporary achlorhydria, while later, when the altered hormone of

the thyroid gland attacks that portion of the chain for which it has a definite affinity there will result either achlorhydria, diminution of free hydrochloric acid, or normal secretion according to the a mount of stimulation exerted upon the gastric inhibitory sympathetic nerves by the altered thyroid hormone. In this interpretation of the mechanism of gastric secretion in hyperthyroidism hyperchlorhydria must be interpreted as an aberrant finding not due to the presence of the hyperthyroidism and, as the results show, the alteration in gastric acidity caused by hyperthyroidism tends always to a diminution from the normal.

CONCLUSIONS

From the above evidence the theory is offered that:

1. The symptoms of hyperthyroidism can be interpreted in terms of an increased sympathetic drive due to the action of the altered thyroid hormone causing an oversensitization of the thoracico-lumbar sympathetic system which over-rides the normal antagonistic moderator action of the parasympathetic.

2. The drive is present with varying intensity in the different portions of the sympathetic system and the relative preponderance of ocular, cardiac or gastric symtoms depends upon the degree to which the various parts of the sympathetic mechanism are affected by the altered thyroid secretion.

3. Interpreted in terms of the secretion of free hydrochloric acid the increased sympathetic drive causes a stimulation of the inhibitory acid-secreting fibres of the gastric mucosa and results in a diminution or lack of secretion of acid.

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CARDIAC ARREST

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There is perhaps no complication of the operating room that more nearly approaches tragedy than that of cardiac arrest. At once a smooth-working operating force may be thrown into a situation that borders on panic.

From the literature, one gathers evidence of the desperate efforts that have been brought forth to combat this unsuspected and unforeseen situation. In a small number of cases, a successful issue has been brought about, and, in a still larger number, life has been prolonged for hours with the heart restored to rhythmic contraction during that time.

It is likely that there are a large number of cases of cardiac arrest in which no effort at cardiac resuscitation has been attempted other than the use of stimulants, intracardiac and intravenously. However, these procedures are rarely successful if the circulation has ceased.

If the profession can be brought to the belief that no case of cardiac arrest has had every effort at life-saving exhausted, until direct cardiac massage has been done or the physiological resuscitation method of Crile resorted to, or both, I am sure we are going to have a greater number of successful cases reported.

In 1923, Borst [1] reported seventy-seven cases of cardiac arrest in which cardiac massage had been resorted to, with twenty successful issues. In 1924, Lee and Downs [2] added to this twenty-four more cases, making a total of 101, with twenty-five successful issues. In 1926, W. Girling Ball,[3] R. M. Glover [4] and Leo Doyle [5] each reported a successful case of cardiac massage. W. Stanfield [6] and L. Cook [7] reported cases of successful restoration of rhythm, but death a few hours later.

In the case of Ball, Glover and Doyle, it was possible to resume the operation after restoring cardiac rhythm.

These reports alone should furnish sufficient stimulus to encourage renewed effort, not only in combating the condition, but in equipping the operating room for such an eventuality, since the time allowed for successfully putting into effort the necessary procedures for combating cardiac arrest does not admit of waiting. The equipment must be ready for immediate use.

The cardiac arrest in the operating room is either primarily cardiac or secondary to vaso-motor relaxation. In both types it is probably associated with ventricular fibrillation.

There has been a great decrease in cardiac death from ventricular fibrillation since the abandonment of chloroform. Cardiac failure secondary to vaso-motor relaxation may be foretold by repeated blood-pressure readings

during anæsthesia and often prevented by intravenous injections of fluid. Indeed, the blood-pressure may be maintained over a long period of time during an operation by the repeated injections of fluid, especially gum acacia solution (Adson and McIndoe, Surgical Clinics of North America, August, 1929).

Blood-pressure may fall fifteen or twenty points and remain so for some time before vaso-motor relaxation is clinically demonstrated. When it is manifested clinically, it appears with such suddenness that the heart is robbed of the essential fluid passing through it and fails suddenly.

It has been shown by Crile, Dolly, and Markowitz and Mann[8] (Surgical Clinics of North America, August, 1929) that if the pressure in the coronary arteries falls below 70 for a half-hour, the heart becomes arrested.

It has been demonstrated in animals with the heart removed from the body, that rhythm may be restored by the injection of fluids or air into the aorta in sufficient quantity to raise the pressure in the coronary vessels.

It has further been shown in experiments upon dogs that rhythm may be restored to the quiescent heart after a period of five or six minutes with the animal to all intent and purposes dead, by injecting into the left common carotid artery a solution of 1-50,000 adrenalin in normal saline (Crile, Markowitz[9] and Mann). This fluid finds its way into the aorta and ultimately into the coronary arteries. As soon as the intra-coronary pressure reaches a definite point, the cardiac rhythm is restored. If this be then followed by intravenous fluids, the vaso-motor tone may be restored and a benign circle established and the heart given an abundance of fluid upon which to work. If the heart remains quiescent, however, for more than six minutes, the animal may recover physical function, but is always damaged mentally, showing that the cerebral anæmia creates a more rapid degeneration in the cells of the cerebral cortex than it does in those of the medulla. It is at once apparent then that rhythm must be restored to a quiescent heart within a period of six minutes if we hope to restore the individual to complete normality.

Several methods for approaching the heart have been described. The one formerly used was the osteoplastic flap through the chest wall. Later an opening through the dipahragm large enough to admit the hand was advanced. Borst suggests an opening in the diaphragm near the costal border because of less likelihood of hæmorrhage and greater facility of closing such a wound. These transdiaphragmatic openings were undertaken with the hope of preventing lung collapse and pneumothorax, and are especially applicable to those cases occurring during abdominal operations where the abdomen is already open. The approach through the chest wall has the advantage of bringing the heart into sight and the oxygen pressure from the anæsthesizing machine will readily distend the lung after it has collapsed. By cutting through the costal cartilage, this flap of rib and soft part can be held aside with the retractor and thus give ready access for the hand and vision.

Respiration usually fails completely with cardiac arrest and may be

difficult to restore as it was in the report which follows. Indeed, Keen [10] makes the assertion that it is much easier to establish cardiac rhythm than to resuscitate the vaso-motor or respiratory centers. By keeping the lung distended with pure oxygen, it seems reasonable that sufficient oxygenation will take place until respiratory rhythm has been resumed. This was demonstrated in the successful case of W. Girling Ball (British Medical Journal, April 24, 1926).

It is extremely unlikely, with our present knowledge, that much success at restoration of rhythm can be expected in badly diseased hearts if quiescence has occurred. As a contribution to the literature of this subject I submit the following case report:

A colored woman, who gave her age as fifty-two years, was admitted to the service with senile gangrene of the right foot. The gangrene was of the dry type of four weeks' duration, preceded by periods of coldness and tingling in the foot. The line of demarcation was well defined. Urinary findings were negative, as were blood findings, except for slight leucocytosis. There was a marked general arteriosclerosis. The heart was normal in size with well-defined rhythm and normal sounds. The blood-pressure on the table before operation was $\frac{140}{80}$ $\frac{\text{systolic}}{\text{diastolic}}$ as had been determined previously. Amputation of the limb at the point of election, under light anæsthesia, was determined upon.

Operation.—The limb was prepared for amputation and nitrous-oxide anæsthesia begun. After a few deep inhalations the respiration became labored and suddenly ceased. It was not resumed after a few efforts of artificial respiration. No pulse was evident and no heart beat could be determined with the stethoscope and no blood-pressure registering. An intracardiac injection of fifteen minims of adrenalin, 1-1000 was given, and the thorax slapped and compressed over the heart without avail. An intravenous injection of 1-50,000 adrenalin in normal saline in the left common carotid artery was immediately started and 200 c.c. of this fluid allowed to run into the aorta. The heart was still quiescent; no respiratory function and no blood-pressure recorded.

An incision through the soft parts and costal cartilage from the third and seventh ribs was quickly done, but with no attempts at osteoplastic flap. This incision could be retracted so as to permit insertion of the hand as well as give good vision, the left lung having immediately collapsed. The heart was quiescent and distended. On the third effort at emptying, the rhythm was restored with force and regularity and a blood-pressure recorded of 140/90.

However, no respiratory effort was maintained. The incision through the chest wall was closed and the lungs distended with CO-2, both readily filling. The lungs were allowed to empty and were then refilled with CO-2. This was repeated several times, without any effort at restoring the respiratory function. The heart began to fail again and finally became quiescent for a second time.

The chest wound was hurriedly reopened and massage begun again. Again the heart responded but with a great deal of fibrillation. The maximum dose (130 minims) of digifolin was now injected directly into the left ventricle with definite improvement of rhythm and cessation finally of fibrillation. It was felt that there was some connection between the administration of CO-2 and the second period of quiescence. After closing the chest a second time the lungs were distended with oxygen and kept so for nearly five hours following. At intervals of ten minutes the lungs were allowed to gradually empty themselves of oxygen and were then refilled. Apparently sufficient oxygen was obtained since there was no evidence of cyanosis and the blood looked to be of good red color.

During the five-hour period of no respiratory effort the heart rhythm was good and systolic blood-pressure maintained at 180. Each time the lungs were allowed to empty and effort at manipulating the epiglottis and arytenoids with the finger was done. I was finally successful in restoring continuous respiratory function after a five-hour period of cessation. The rate was first eight per minute, increasing to twelve, then sixteen, and, finally, twenty per minute one hour after its reëstablishment.

The patient went on then for three hours with good cardiac rhythm, blood-pressure 180/90 and deep, full respiratory efforts at twenty per minute. Pulse rate 110. At the end of this time the blood-pressure began to fall and intravenous fluid (6 per cent gum acacia in normal saline) was given slowly with the hope of combating vaso-motor relaxation. However, the pulse rate gradually increased with blood-pressure falling and respiration becoming more and more shallow until there was complete failure of heart-beat and respiration one hour later.

The length of time that elapsed from the first period of quiescence to the ultimate failure was a little over nine hours. The first period of quiescent heart lasted six minutes, the second three minutes. In the interval between these two periods good rhythm was maintained for ten minutes. For five hours there was no voluntary respiratory effort. The patient never reacted or showed any consciousness or made any movement during this nine-hour period, although good heart rhythm, good respiratory rhythm and good blood-pressure were maintained.

In the face of advanced arterial disease it was felt that this was a most unfavorable case for good ultimate result. It is probably that the cortical and medullary centers were too badly damaged by the anæmia attendant upon the quiescent heart to admit of complete recovery.

COMMENTS

1. The occurrence of cardiac arrest is perhaps more frequent than we are inclined to think. It may be the cause of death in a large majority of the cases that occur on the operating table, whether it be primarily a cardiac failure or cardiac failure secondary to vaso-motor relaxation.

2. Primary cardiac arrest can be combated successfully by cardiac massage. Cardiac arrest secondary to vaso-motor relaxation can be prevented by preserving the vaso-motor tone during the operation and combated by raising the intra-coronary tone through intra-arterial injections of fluid followed by intravenous injections of fluid. In this type of arrest direct cardiac massage may also be of great value. The success of the issue depends, to a large extent, on the preparedness of the operating room to combat such an eventuality.

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CHORDOTOMY FOR INTRACTABLE PELVIC PAIN

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Most of modern surgery is confined to the performance of procedures that might be classified as curative in nature, while those operations that might be classified as palliative occupy a rather insignificant place. This probably is as it should be because palliative surgery, in general, is somewhat disappointing. Of such palliative operations we might refer to that of gastrostomy for the relief of cancer of the œsophagus, an operation that may restore the former nutritional condition but also subjects the patient to the repeated suffering of an exitus delayed only by a period of months. It undoubtedly is more beneficent therapy to let this unfortunate condition destroy itself straightway rather than to perform the palliative gastrostomy. The same statement applies to the operation of gastroenterostomy in the cachectic patient suffering from carcinoma of the pylorus. Similarly, the suprapubic cystostomy for irremovable cancer of the prostate is of questionable benefit and likewise the palliative decompression for extensive gliomas of the brain frequently carries little to commend it. Operations for the relief of pain, however, stand in an altogether different category from those referred to above. The division of the sensory root of the trigeminal nerve for neuralgia is one of the great accomplishments in surgical therapy as is also the operation of chordotomy. The latter operation was carried out in the case which is the subject of the present report.

Case.—A white man, forty-nine years old, was admitted to the Lakeside Hospital, February 8, 1930, complaining of pain in the pelvis and the lower abdomen on the left side. The family history contained nothing noteworthy. The patient had poliomyelitis at the age of three years, leaving him with a residual paralysis and atrophy of the right leg. Since this illness, he has walked with a crutch. He had typhoid fever in 1904 and an appendectomy for acute appendicitis in 1924. He worked in a machine shop and in spite of the paralysis and atrophy of the right leg, was able to do manual work. January 16, 1928, a heavy lathe impinged him upon a cement floor, compressing the pelvis and lower abdomen. He was brought to the Lakeside Hospital in a condition of serious shock. He had sustained a crushed pelvis and a rupture of the bladder. A transfusion of 500 cubic centimetres of blood was given and the rupture of the bladder was repaired. The X-ray of the pelvis showed the left ilium, both ischia and the left pubis, to be fractured. There were several small particles of bone lying near the left sacro-iliac joint, although the joint itself seemed to be in fair alignment. The left transverse process of the fifth lumbar vertebra was fractured. Throughout the period of convalescence in the hospital, the patient suffered considerable pain in the region of the fractures. A brace for the back and pelvis was procured and the patient later became ambulatory with two crutches. The pain was of a dull, boring, constant nature. He was discharged March 29, 1928.

In February, 1929, the patient developed an ischio rectal abscess which was opened and drained at this hospital. Subsequently, this drainage tract closed.

The patient has been totally unable to work. On February 8, 1930, the severity and the chronicity of his pain forced the patient to reënter the hospital for its relief. The pain was localized almost entirely between the costal margin on the left and the lower part of the pelvis. What discomfort existed on the right side of the pelvis was very slight. The pain was constant both day and night. Except for the pain and the atrophy of the right leg, the general condition was good. In view of the fact that the pain was localized almost entirely to the left side, it was thought that section of the pain fibres on the right side of the cord would give relief. The operation was explained to the patient—that he would lose the sensation of pin-point pain and the sensation of heat and cold on the left side. The patient readily accepted operation.

Accordingly, on Febuary 17, under novocaine anæsthesia, laminectomy was carried out over the fourth, fifth, and sixth thoracic vertebræ. The dentate ligament on the right side of the spinal cord was picked up in a small clamp and the cord rotated to the opposite side. This exposed the anterolateral tract on the right side. The point of a scalpel was inserted just anterior to the dental ligament to a depth of 3.5 millimetres and carried forward for about the same distance. The area of anæsthesia on the left side of the body was then determined and it was found to be adequate. The operative wound was sutured. The patient immediately felt relieved of the former pain.

The convalescence was uneventful and the patient was discharged from the hospital March 19, 1930. The area rendered anæsthetic to pin-point pain extended from the costal margin on the left downward over the pelvis and left leg. The sensation of heat and cold was lost over this area. The sensation of light touch was preserved. The reflexes were normal. The sense of position and the vibratory sense were normal. There was no motor involvement; and there was no difficulty in urination.

The patient was last seen April 4, 1930, at which time he was delighted with the result. The operation has given him the only freedom of pain since the accident, two years ago. He sleeps the whole night and he walks with much greater freedom than he did. The patient believes he will be able to get back to work. A few days ago a kitten ran up the left leg and the patient was unaware of it. He has paradoxical heat and cold sensations.

Discussion of the Operation.—The localization in the spinal cord of the conduction pathway for pain was suggested by Gowers in 1879 and by Van Gehuchten in 1893. That the sensations of pain and temperature passed up the cord in Gowers' tract had no positive proof in man, however, until a brilliant observation was made by Spiller[1] in 1905. This observation was a correlation between a clinical condition consisting of the loss of sensation for pain and temperature in the legs with the preservation of tactile sensibility, and the pathological condition of a solitary tubercle located in each tract of Gowers at the level of the lower thoracic cord. In this tract were accurately localized, therefore, the pathways for pain and temperature. It contained no motor fibres and no other important sensory fibres. That it could be sectioned for the relief of intractable pain was proposed by Schüller[2] in 1910 and by Spiller[3] in 1911.

The first chordotomy was performed by Spiller and Martin[3] in 1911 and the second by Beer[4] in 1912. Later, the operation was performed by Tietze[5] and by Elsberg,[6] and in 1920 a series of six cases was published by Frazier.[7] Subsequently, a number of reports on the subject appeared by Leighton,[8] Frazier and Spiller,[9] Peet,[10] Foerster,[11] Sicard and Robineau,[12] Sicard,

Haguenau and Wallich,[13] Robineau and Banzet,[14] Aievoli,[15] Horrax,[16] and Beck.[17] Within recent years the operation has gained favor.

The operation is not difficult to perform, although the section of the anterolateral columns must be done with accuracy and precision. The level for the laminectomy varies with the case. The section of the fibres should be at least four or five segments above the area to be rendered analgesic. As a general rule, the division is carried out at the level of the fourth, fifth, or sixth thoracic vertebra. For upper abdominal pain, Peet[10] advises division of the posterior nerve roots together with chordotomy.

Two or three posterior spinous processes are removed together with their laminæ. The dura is opened throughout the length of the incision. The arachnoid is identified laterally on each side to its attachment with the cord at the dentate ligament. The latter structure is an important landmark and lies between the anterior and posterior nerve roots. The arachnoid is opened along the mid-line posteriorly. Retraction of the arachnoid exposes the dentate ligament and the posterior roots. The dentate ligament is grasped in a small clamp. (Fig. 1.) Gentle traction upon the dentate ligament rotates the cord and exposes the anterolateral column. It is this column that carries contralateral pain and temperature fibres. These fibres lie in the area between the dentate ligament and the line marking the emergence of the anterior roots from the cord and extends to a depth of three and one-half millimetres.

FIG. 1.—Laminectomy was performed at the level of the fourth, fifth and sixth thoracic vertebræ. The clamp placed on the dentate ligament rotates the cord to the left. The point of the knife is inserted 3.5 millimetres at the attachment of the dentate ligament and carried anteriorly to the point of emergence of the motor nerve root.

It is important that at the level of the emergence of the anterior root the incision should be at a depth of three millimetres. To carry out the section of these fibres a slender tenotome knife is satisfactory. One should mark the blade three or three and one-half millimetres from the point. The knife is then inserted into the cord at the dentate ligament to the mark on the blade and carried forward to emerge at the exit of an anterior root. (Fig. 2.) If bilateral chordotomy is indicated, the procedure is carried out in the same way on the opposite side.

Following division of the anterolateral tracts, there should be complete loss of pain and temperature sense on the opposite side, depending upon the level and depth of section. If the section be carried to an insufficient depth, the area of analgesia may be much lower and incomplete. This may necessitate a repeated operation. The motor function is not impaired. Tactile, vibratory and postural perceptions are not impaired. The reflexes are preserved.

Since the fibres entering the cord ascend several segments before they cross to the contralateral side, the operation must be performed several segments above the segment level of the pain. The highest level at which section of the anterolateral column could be made without involving the phrenic nerve is at the level of the sixth cervical segment. From this consideration alone, the application of this operation is limited to those conditions in which there is pain below the third thoracic segment. This area includes the trunk, pelvis and legs. In those cases in which pain is present in the pelvis and legs, the level for the chordotomy is determined where it is most conveniently carried out at operation; namely, the mid-thoracic region.

We recommend the operation for relief of any form of intractable pain in the abdomen, pelvis or legs. It is preferable to rhizotomy, an operation consisting of the section of the posterior nerve roots. Rhizotomy not infrequently fails to give complete relief and its failure is usually due to the fact that the nerve roots cannot be sectioned over a sufficiently wide area. Chordotomy can be carried out without sacrificing any motor fibres or any other important sensory fibres except those of temperature. The conditions for which the operation has been carried out are as follows: malignant disease primary in the spine, gunshot injury of the spine, tabes dorsalis, carcinoma of the rectum, myelitis, carcinoma of the cæcum, carcinoma of the uterus, carcinoma of the prostate, carcinoma of the breast, carcinoma of the lung, retroperitoneal malignancy, sarcoma of the thigh, shell wound of the sciatic nerve in the pelvis, pain in the vagina and rectum of unknown origin, pain of unknown etiology in the legs associated with spasmodic contractions, and avulsions of of the lumbosacral plexus. The cases of malignancy had metastases to the spine, pelvis, or pelvic glands with involvement of the lumbosacral plexus.

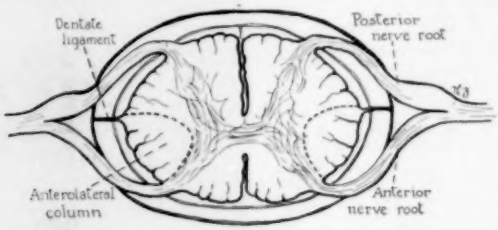

FIG. 2.—Cross section of the cord showing the anterolateral column in relating to the dentate ligament and the posterior and anterior nerve roots.

In one of our cases in which the bilateral section was carried out, dribbling at urination occurred. When the bilateral operation is carried out we advise the section of the tract to be made not deeper than three millimetres on each side. If the operation be carried out under local anæsthesia, the section of the tract can be repeated to obtain the desired height. Of the nineteen cases reported by Peet,[10] complete relief of pain was obtained in sixteen, partial relief in two, and complete but apparently temporary relief in one.

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THE MORTALITY AND LATE RESULTS OF SUBTOTAL GASTRECTOMY FOR THE RADICAL CURE OF GASTRIC AND DUODENAL ULCER*

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It is well, at the very outset of this paper, to state emphatically that ulcer of the stomach is the same disease as ulcer of the duodenum. So far as we know, an ulcer situated in either viscus depends upon the same causes for its formation, has the same life history, is amenable to the same methods of treatment, and in the chronic stages can be radically cured in only one way, and that is by surgical operative methods. This statement is made because it has become the practice of a good many internists and surgeons to deal with ulcer of the stomach as though it were an entirely different disease from ulcer of the duodenum. Thus, for example, a great many surgeons advise and carry out a subtotal gastrectomy for the radical cure of gastric ulcer but strongly object to this operation for the radical cure of duodenal ulcer. Such surgeons are perfectly willing to resort to deforming and mutilating operations upon the stomach to get rid of a gastric ulcer but they are unwilling to employ such mutilating and deforming operations on the stomach for the radical cure of duodenal ulcer. It would seem logical that if a particular kind of operation is used to bring about a cure in gastric ulcer the same kind of operation should be employed to bring about this result in a similar disease when it is situated in the duodenum.

In previous communications I have dwelt in detail upon our conception of what is necessary for the formation and development of a gastric or duodenal ulcer. According to our idea there are three important factors concerned in the formation and development of such an ulcer. These factors are the existence of a *specific ulcer gastritis, the presence of free hydrochloric acid in the stomach,* and *the presence of a secondary infection in the stomach or duodenum,* usually with the green streptococcus. All three of these factors must be in evidence. As regards the specific ulcer gastritis, the writer is well aware that some eminent pathologists consider that the gastritis is attendant upon and due to the ulcer and not one of the underlying conditions of ulcer formation. It must be conceded by them, however, that a specific ulcer gastritis may exist before an indurated ulcer developes, but with every ulcer a more or less extensive specific gastritis is present. A tendency to develop a chronic specific ulcer gastritis may be inherited or it may be acquired. It is well known, for example, that ulcer of the stomach or duodenum frequently occurs in several members of a family and is more

* Read before the Surgical Section of the New York Academy of Medicine.

prone to occur in individuals of a particular physical character. On the other hand, it is equally well known that the tendency to the formation of a chronic ulcer gastritis occurs after severe pestilence, after exhaustive disease, after war, and other forms of physical and nervous shock.

The symptoms of *chronic ulcer gastritis* may be present for a long time before the actual formation of ulcer. These symptoms are of the same character as those of ulcer. This explains why, in some patients who have a typical ulcer history, no ulcer is found at operation, or at the autopsy table. A patient with a chronic specific ulcer gastritis sooner or later develops an ulcer if the gastric contents are acid and a secondary infection is present. In the early stages of a specific ulcer gastritis medical treatment can influ-

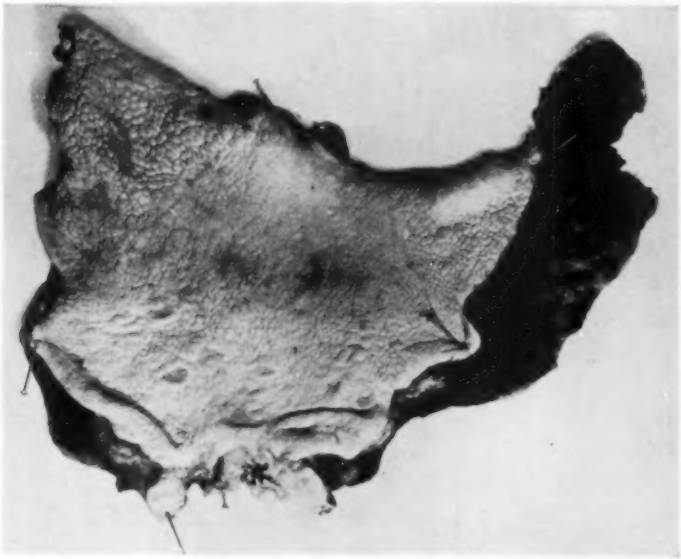

FIG. 1.—Partial gastrectomy for duodenal ulcer. Note the *extensive polypoid* gastritis in the whole of the antrum, which precedes the development of gastric and duodenal ulcer.

ence those factors which cause it to persist but when the ulcer is fully developed and has persisted for a number of months prior to the employment of medical treatment, then dietary and medical means can usually only alleviate and rarely bring about a permanent and radical cure. We are accustomed to define an ulcer of the stomach or duodenum as an infected abrasion resulting from a specific gastritis in the presence of free hydrochloric acid.

It must be clearly understood that in our clinic, operation for ulcer of the stomach and duodenum is undertaken only after repeated failures of medical treatment to cure. The patient with ulcer of the stomach or duodenum is always referred to the internist for one or more dietary and medicinal treatments and only when these fail to cure or alleviate is operation advised. Of course, sudden perforation is treated at once by operation and the individuals who have cicatricial stenoses and deformities of the stomach as a

result of an ulcer have had the benefit of medical treatment prior to the time they come to us.

Up to 1920, we followed, in our clinic, the customary methods of treatment for the cure of gastric and duodenal ulcer. We employed, at various times, the operations of gastroenterostomy, ulcer excision, cautery puncture, and pyloroplasty. These operative procedures did not give us satisfactory *late results*. We found, in our follow-up of these patients, that only about 50 per cent. were cured and that at least 30 per cent. developed new ulcers at the gastroenteric stoma or had recurrent ulcers at the site of the original lesion. These results were published by my colleague, Doctor Lewisohn. They were substantiated by the results of a number of continental surgeons, notably Bier, Payr, Von Haberer, and others. We found, in our follow-up investigations (and this should be continued for ten years), that patients who had been subjected to one or the other of these operations were frequently much worse off than they had been before operation. Their sufferings were much more severe, and, whereas before these operations had been performed they had obtained some relief from medical treatment, no such relief was obtainable from diet and medication when new ulcers formed at the new stoma or recurrent ulcers developed at the site of excision or pyloroplasty.

The disappointing late results of these operations and the equally disappointing late results of medical treatment led us to seek for new methods that would afford a lasting cure. If our conception of the factors concerned in the development of an ulcer was basically true, then any operation which was to be applied for the lasting cure of gastric or duodenal ulcer would, of necessity, have to remove these factors; namely, it would have to remove the chronic specific gastritis, it would have to render the stomach anacid, and it would have to do away with the secondary infection. The procedure that would most nearly satisfy these conditions was a partial or subtotal gastrectomy.

We had sporadically performed partial gastrectomy for gastric and duodenal ulcer since 1900 and we were impressed by the fact that patients who had been subjected to a partial gastrectomy were cured of their disease. In Germany and Austria this operation was gaining markedly in favor, especially by Von Haberer and Finsterer, and we determined to employ this operation as routine procedure for the cure of gastric and duodenal ulcer. We came to this decision in 1920.

At that time there was no standardized plan of carrying out this operation. The operation, of course, is to be divided into two parts: *first, the removal of the antrum and part of the body of the stomach, together with the pylorus and affected portion of the duodenum;* and, *secondly, the reëstablishment of the connection between the stomach and the duodenum or jejunum*. The first part of this procedure had been approached in different ways by different operators. Some advised removing the first portion of the duodenum, pylorus, antrum, and portion of the body of the stomach in a

retrograde fashion; that is, from the duodenum towards the upper end of the stomach. Others recommended commencing at the upper end of the stomach and removing the same parts from above downward. Some opened the duodenum and with the finger inside its lumen peeled out the perforated, adherent, ulcerated portion of this viscus from the head of the pancreas and neighboring structures. The points of danger in the removal of this portion of the stomach and duodenum were not known or dwelt upon. It was necessary, therefore, to establish a definite method of procedure that would have in view a safe and speedy removal of the portion of the stomach, pylorus, and duodenum.

As regards the second part of the operation, *viz.*, the reëstablishment of the gastroenteric circulation, here again various operators followed different methods of procedure. Von Haberer used the method of Billroth No. 1; namely, end-to-end gastroduodenostomy, and he reported good results therewith. Later on, he found that this method was not applicable to all cases of duodenal ulcer because frequently the ulcer was situated below the normal peritoneal investment of the duodenum. In such cases he used gastroduodenostomy, end-to-side, implanting the cut end of the stomach into the side of the duodenum. Finsterer, on the other hand, was using the method of Billroth No. 2 with gastrojejunostomy. Some operators were making a gastrojejunal ante-colic (long loop) anastomosis, while some made it retrocolic with no loop. Some combined jejuno-jejunal anastomosis with a gastrojejunal implantation. Some operators used Murphy buttons for the anastomosis.

With an open mind we approached the subject of how to reëstablish the gastroenteric circulation. In 1921, 1922, and part of 1923 we used successively the various methods of gastroduodenal and gastrojejunal anastomosis. We were not at all satisfied with the results of the Billroth No. 1 or of the Billroth No. 2 either as regards motility of the stump of the stomach or as regards the applicability of the Billroth No. 1 to deep penetrating ulcers of the duodenum. We employed each one of these methods of anastomosis in a number of cases and observed the results both as regards motility and function of the stomach. The Murphy button was the least satisfactory. Though, by its use, ten to fifteen minutes of time were saved, and though it could be employed in cases where the ulcers were situated high at the cardia and the usual suture methods of anastomosis were entirely non-applicable, still, its routine use was not attended with satisfactory results. The lumen of the button would often become closed by gastric secretions or by a little blood; patients would vomit and it seemed as though post-operative pneumonia was more common with this than with the other methods of anastomosis. Thus we went from one type of anastomosis to another until, in November, 1923, we independently devised the method of gastrojejunal implantation which we subsequently found had been described and pictured by Kronlein and Hofmeister. Almost from the first the procedure gave us very satisfactory results and from November, 1923, we adopted it as routine

anastomosis between the stump of the stomach and the first portion of the jejunum. The entire operation—removal of a portion of the body, antrum, pylorus, and affected portion of the duodenum—and the method of reëstab-

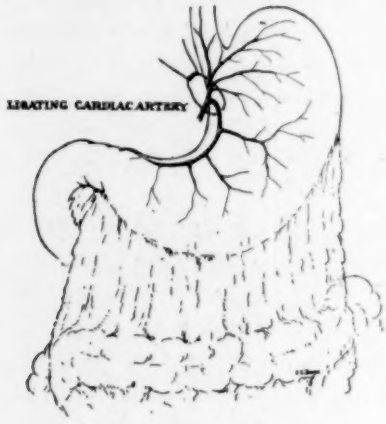

FIG. 2.—First step in partial gastrectomy is ligation of the cardiac artery two inches above the incisura angularis.

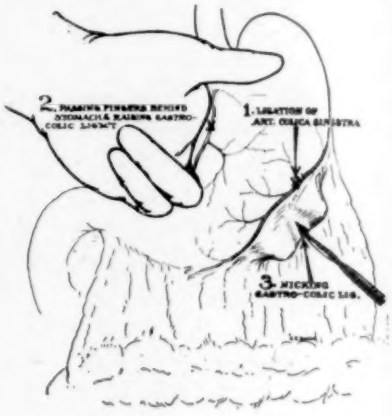

FIG. 3.—The index and middle fingers break through the gastro-hepatic omentum, pass behind the stomach and put the gastro-colic ligament on the stretch. The latter is incised at a point directly opposite to the site of ligation of the cardiac artery and the left gastro-colic artery is clamped and divided.

lishing the anastomosis between the stomach and jejunum, according to the descriptions of Hofmeister, were published by me in the Surgical Clinics, in 1925. I am illustrating this procedure again. This method of removing an

FIG. 4.—The gastro-co'ic ligament is divided between clamps, below the arch of the gastro-colic arteries. During this procedure the upper layer of the transverse meso-colon is carefully pushed away from the posterior wall of the stomach, so as to avoid the middle colic artery.

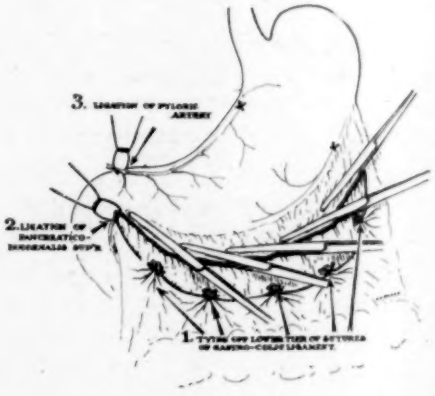

FIG. 5.—The pyloric artery is clamped just beyond the pylorus, divided and ligated.

ulcer in the stomach or duodenum is simple and when one has acquired dexterity it can be rapidly and accurately accomplished.

We have adopted it as a routine procedure and as a standardized opera-

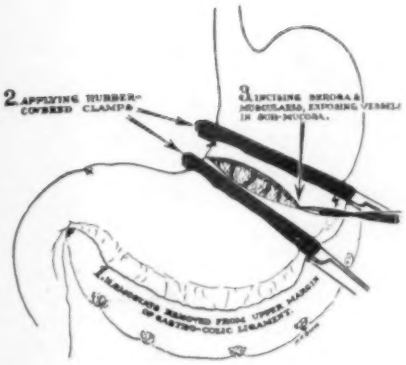

FIG. 6.—The arterial supply of the portion of the stomach to be removed, the pylorus and first portion of the duodenum has been ligated, and two long straight clamps are applied to the stomach. The stomach wall is to be divided between the clamps.

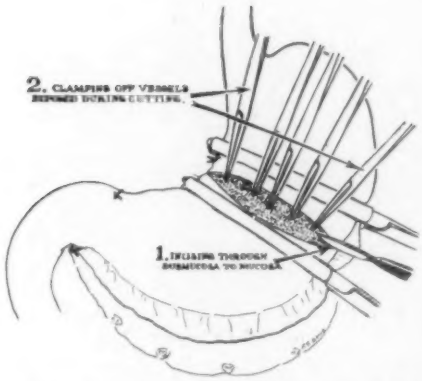

FIG. 7.—The serosa and muscularis of the gastric wall are cut through, thus exposing the intrinsic gastric vessels, which are caught with small clamps, divided and ligated.

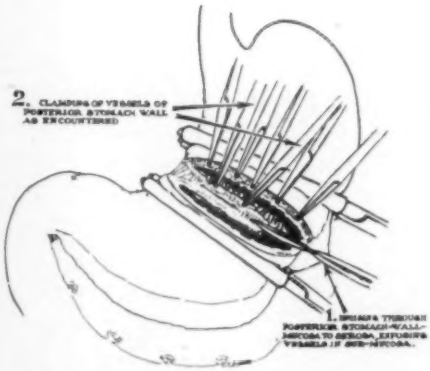

FIG. 8.—On the posterior gastric wall the mucous membrane is divided first and the intrinsic gastric vessels caught and ligated.

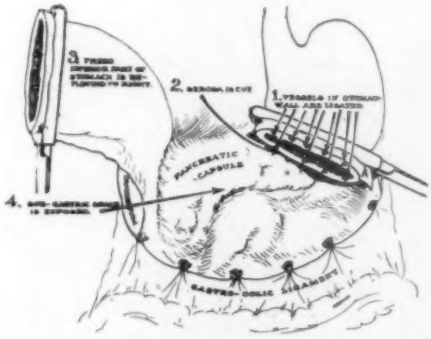

FIG. 9.—The distal stump of the stomach is covered with a pad and turned to the right, thus exposing the head of the pancreas, the peritoneal reflection of the meso-colon on to the posterior, duodenal wall, and the posterior duodenal wall. The proximal gastric stump is covered with a pad.

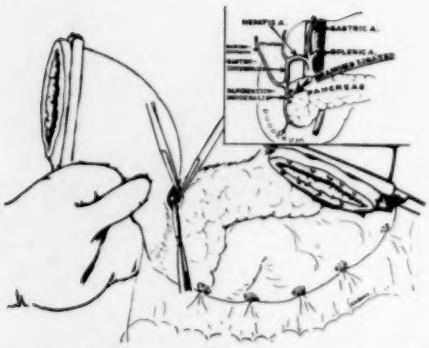

FIG. 10.—Dividing the peritoneal reflection onto the posterior duodenal wall, so as to separate the duodenum from the pancreas. It is important to keep outside the capsule of the pancreas. During this separation several branches of the pancreatico-duodenal artery are usually divided. They must be carefully clamped and ligated.

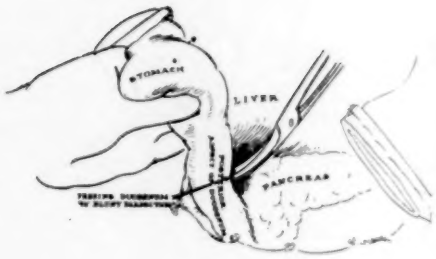

FIG. 11.—Freeing the duodenum from the pancreas either by blunt dissection or with sharp knife. Care must be taken to keep outside of the capsule of the pancreas.

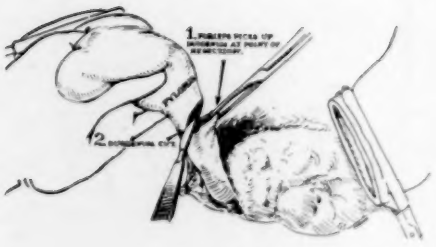

FIG. 12.—Cutting across the duodenum *without* the use of clamps below the ulcers. The absence of clamps enables the operator to look into and palpate the duodenum.

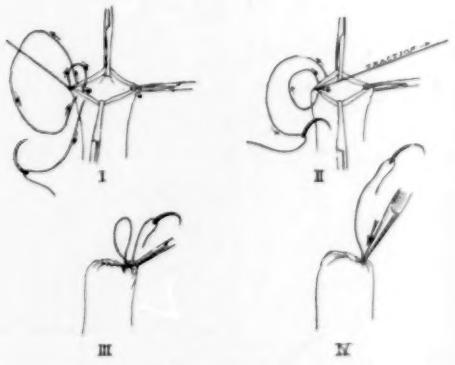

FIG. 13.—Closure of the duodenal stump by two layers of sutures. First layer is a through and through suture of catgut, passed mattress fashion, from without inward. The mucous membrane must be carefully turned in.

tion. As shown in the illustrations, the operation commences at a definite point (the ligation of the cardiac artery) and proceeds from that point straight ahead in successive stages until the desired portion of the stomach

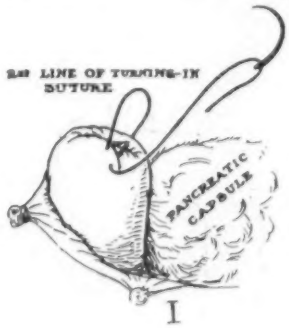

FIG. 14.—I. The second layer of sutures is of catgut or linen passed in purse-string or mattress fashion.

FIG. 15.—II. The duodenal stump is peritonealized by sewing the peritoneum of the transverse meso-colon over to the anterior duodenal wall.

and duodenum has been removed and then a gastrojejunal anastomosis is established according to the method of Hofmeister. This routine, standardized procedure is deviated from only when local conditions demand it. There are a number of "don'ts" that must be strictly observed. First, and principally, too much stress cannot be laid upon avoiding entrance within the pancreatic capsule while mobilizing the duodenum. Such an act opens the door to infection of the pancreas and its consequent evil, frequently fatal, results. Ulcers that penetrate within the capsule of the pancreas are usually surrounded by an inflammatory wall and it is highly important to keep inside the limits of this inflammatory wall. Again the bed of an ulcer, penetrating on or into the head of the pancreas, must be well cleaned with iodine. Especially important is it to avoid any hematoma around the head of the pancreas or around the duodenal stump. Such hematomata frequently become infected and thus occasion pancreatitis, peritonitis, duodenal fistulæ, *etc.* Finally, it is very important to cover over all the raw areas left in the dissection by sewing the upper layer of the transverse meso-colon to the anterior wall of the duodenum so as to prevent accumulation of secretions in these raw spaces. Such secretions easily become infected and, in their turn, give rise to peritonitis, fistulæ, etc.

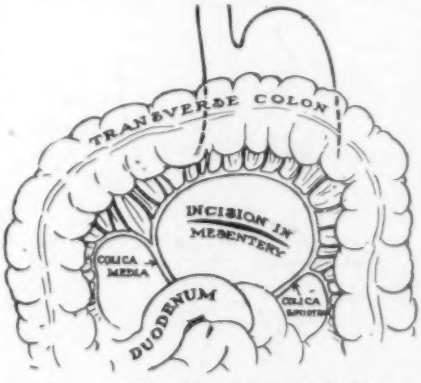

FIG. 16.—The first step in establishing the gastro-jejunal anastomosis, according to the method of Hofmeister, is to incise the transverse mesocolon in a vascular free portion.

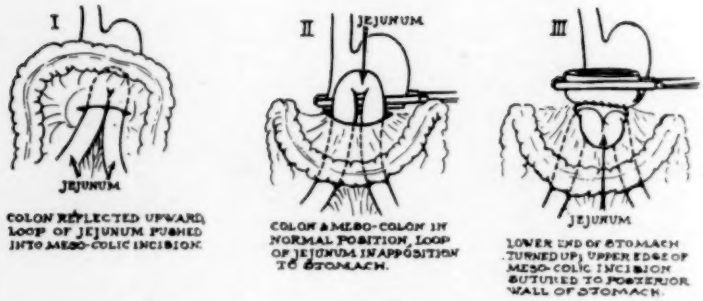

FIG. 17.—A loop of the jejunum just below the fossa of Treitz is drawn up through the opening made in the transverse mesocolon and a part thereof that will ride easily when attached to the cut end of the stomach (without a loop between this part, and the fossa of Treitz similar to a no loop posterior gastro-enterostomy) is grasped in a long, straight, intestinal clamp. The one edge of the opening made in the transverse mesocolon is attached by a few sutures to the posterior wall of the stomach (Fig. III).

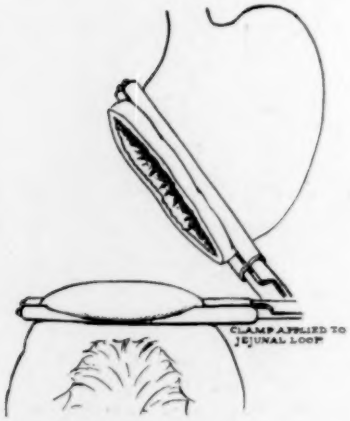

FIG. 18.

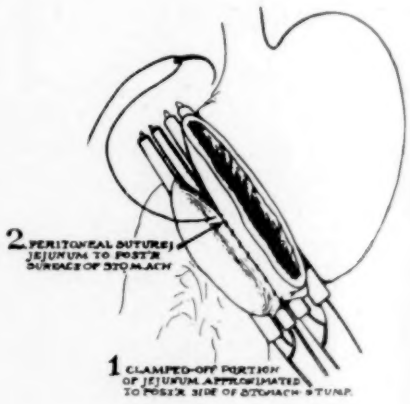

FIG. 19.

The clamp on the stump of the stomach is approximated to the clamp on the jejunum and an implantation of the cut end of the stomach into the jejunum is made in the typical way.

The closure of the duodenum must be done with meticulous care. The first layer of sutures is a through-and-through mattress one, passed from without in, and *the mucous membrane must be carefully turned in at all points.* The second layer of sutures may be passed either in purse-string

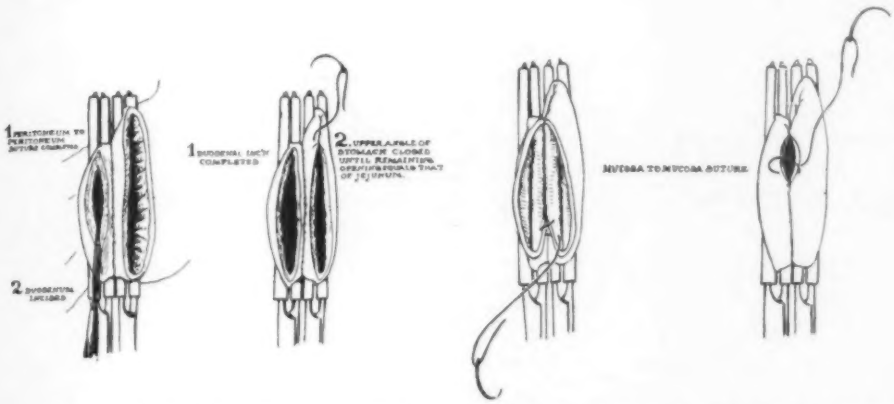

FIG. 20.—Implantation of the cut end of the stomach into the jejunum by two layers of sutures, an inner of catgut and an outer serosal suture of catgut or linen.

fashion, where there is enough peritoneal surface of the duodenum left behind, or the capsule of the pancreas is sewn over to the anterior duodenal wall, thus buttressing the first layer of sutures with the head of the pancreas. If the duodenal suture is carefully carried out, no duodenal fistulæ will result.

Care must be taken not to injure the middle colic artery. This accident can be avoided if the transverse meso-colon is separated from the posterior wall of the stomach before any clamps are applied.

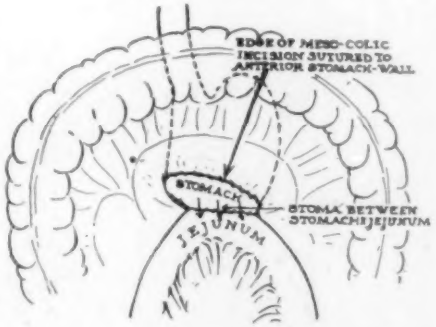

FIG. 21.—Replacement of the jejunum and the anastomosis below the transverse meso-colon and attaching the other edge of the opening in the transverse meso-colon to the anterior wall of the stomach.

The avoidance of hæmorrhage from the cut end of the stomach can be accomplished *in only one way*; namely, by grasping the blood-vessels in the wall of the stomach individually and separately, and tying each one of such vessels. Post-operative bleeding into the stomach may be immediately fatal or it may favor a fatal issue by aspiration of blood into the lungs during vomiting or by materially reducing the resisting power of the individual.

As has been said above, we have followed this standardized routine procedure from November, 1923, and it is to the results obtained in the use of this operation for the radical cure of gastric and duodenal ulcer that I invite your attention. In the first place, to the *immediate operative mortality.* It is important to state at this point that at Mount Sinai Hospital, where the cases reported in this paper were done, we recognize no difference between

hospital mortality and operative mortality. The patient is discharged from Mount Sinai well or dead. It is utterly immaterial how long the patient stays in the hospital. If he dies weeks or months after the operation the death is recorded as an operative death and all these statistics must be viewed in that light.

Total number of primary and secondary operations for ulcer of stomach and duodenum and gastrojejunal and jejunal ulcers:

Ward Service, December, 1923–December, 1929	Primary operations	233
	Secondary operations	81
Private Service, January, 1924–December, 1928	Primary operations	178
	Secondary operations	24
		516

Total number of *primary operations* for ulcer of stomach and duodenum, 411
Of these
Six were at cardia or juxta-cardia
405 were in the stomach below cardia or in the duodenum

Total number of *secondary operations* for recurrent gastric and duodenal ulcers and gastrojejunal and jejunal ulcers, 105

Mortality in primary subtotal gastrectomy

Total number of cases	405
Total number of deaths	32
	7.9 per cent.

Properly exclude from this operative mortality:
1 death—puncture of lung by interne during subcutaneous saline infusion

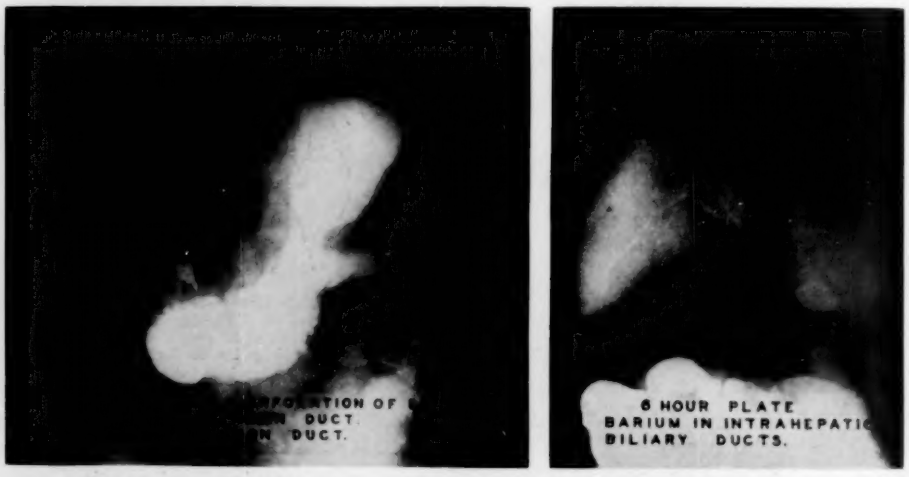

FIG. 22.—The white lines in the liver easily seen with a hand lens indicate the barium in the liver ducts, after a barium test meal.

1 death from transverse myelitis. (Six weeks after operation autopsy showed abdominal viscera entirely healthy)
1 death—pathological, pre-operative, duodeno-choledochal fistula with cholangitis
1 death—patient with *active tuberculosis* in whom operation had been repeatedly rejected by surgeon.

Thus leaving

Total of cases	401
Total deaths	28

6.9 per cent. mortality

This mortality includes every death following primary subtotal gastrectomy during six years of ward and five years of private service.

It includes all bleeding ulcers, active or arrested
all patients with chronic pulmonary lesions
all patients with chronic cardiovascular disease
all patients with tetany
all patients with chronic renal lesions.

It is proper at this point to define what we mean by a *primary* and *secondary partial gastrectomy*. By a *primary subtotal* or *partial gastrectomy* we mean that the patient has had *no previous major gastric operation* done prior to the subtotal gastrectomy. He may have had an exploratory laparotomy, or an appendectomy, or cholecystectomy, or an exploratory gastrostomy, but we mean that there has not been a preceding gastroenterostomy, pyloric excision, pyloroplasty, or closure of a perforated duodenal or gastric ulcer. By a *secondary operation we mean that the patient has had one or more* (in our series the maximum number of preceding operations was fourteen) preceding major gastric operations such as gastroenterostomy, pyloroplasty, ulcer excision, *etc.* The reason for this differentiation is that "preceding major gastric operations" usually result in the formation of more or less dense adhesions between the stomach, omentum, liver, gall-bladder, pancreas, and abdominal wall. The division of such adhesions and the development of the stomach are usually severe operations and contribute materially to shock and post-operative sequellæ. This can be seen when we study the mortality statistics in primary subtotal gastrectomy and in secondary subtotal gastrectomy. In the former, in our own series, the operative mortality has been 6.9 per cent., whereas in the secondary operations the mortality has been 20.9 per cent.

It is of importance to compare the immediate operative results of primary partial gastrectomy with those of gastroenterostomy, *etc.* In a recent publication of the Mayo Clinic (vol. V, No. 9), Doctor Balfour reports the mortality of posterior gastroenterostomy for duodenal ulcer during 1929 at Rochester, Minn., as nine deaths out of 492 cases, 1.82 per cent., and in gastric ulcer as one death out of twenty-one cases, 4.7 per cent. mortality. One must keep in mind, however, the marvelous perfection of technic and the wonderful personnel at the Mayo Clinic. Such happy conditions can hardly be duplicated everywhere and we must not be surprised to find that the statistics at other clinics are not quite so brilliant as those of the Mayo Clinic. Thus the late Doctor Peck reported in the Transaction of the American Surgical Association a mortality of 10 per cent.; Doctor Poole reported, in the same publication, a mortality of 7 per cent. Finney, reporting the results of himself and others in the past sixteen years (Archives of Surgery)

16 per cent., mortality following gastroenterostomy, and Munroe, of Boston, recently published in the Archives of Surgery operative mortality attendant upon gastroenterostomy, pyloroplasty, *etc.*, as 6.9 per cent. In various German publications a similar mortality rate attends operations of gastroenterostomy, pyloroplasty, and ulcer excision. A comparison of the mortality of these operators with that of primary subtotal gastrectomy shows that the latter is materially less.

In the past six years, we have had a number of patients with gastric ulcer situated at, or juxta to, the cardiac opening of the stomach. We call such situated ulcers "high gastric ulcers." As a rule, we operate upon these patients only when we are compelled to, because the attendant risk is exceedingly great. The compelling indications for operation are repeated severe hæmorrhages, perforation, stenosis of the cardiac opening, perigastric inflammation and suppuration. These ulcers are particularly difficult to deal with surgically because the adjoining portion of the œsophageal wall is infiltrated

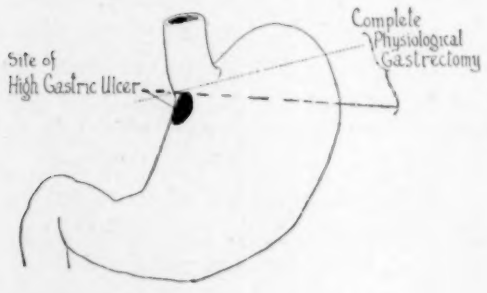

FIG. 23.

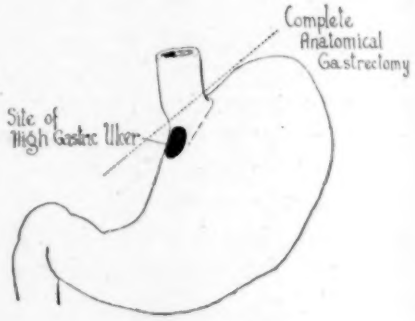

FIG. 24.

Complete gastrectomy may be: (1) *Anatomically complete*, when the line of section is above the cardiac ring. (2) *Physiologically complete*, when the line of section extends from the cardiaa on the right to just below the top of the fundus on the left. The advantage of the latter is an easier and safer gastro-jejunal anastomosis.

by inflammatory tissue, thus rendering suture difficult, and because the incidence of post-operative pneumonia is exceptionally high. We divide the operations which we have employed for the removal of such high-seated ulcers into two types—*total, or anatomically complete gastrectomy*, where the line of division goes through the lower end of the œsophagus at or above cardiac ring, and *physiological complete gastrectomy*, where the line of division goes through *one wall of the œsophagus and through the very topmost portion of the fundus*, leaving just sufficient of the fundus to hold the gastric half of a Murphy's button, by means of which the anastomosis can be readily made with the jejunum.

Number of operations for high gastric ulcer
(By high gastric ulcer is meant one that is *at* or *juxta to* the cardia)
Complete gastrectomy

	No.	Deaths
Anatomically complete	1	1
Physiologically complete	5	3

Secondary operations for recurrent ulcers of the stomach and duodenum and for gastrojejunal and jejunal ulcers including gastrojejunal colic fistulæ. We have already defined secondary operations as those which are performed after one or more primary major gastric operations have been done. We will deal with these secondary operations in detail in a subsequent publication. For the present, suffice it to say that in this series the number of operations performed before the partial gastrectomy was done varied from one to fourteen. In several cases, two preceding gastroenterostomies had been established side by side. In a large number of the cases a primary gastroenterostomy was followed by gastrojejunal ulcer; the latter had been excised, the stoma disconnected, and a recurrent gastrojejunal ulcer had formed. In one, a preceding Finsterer operation had been done (resection for exclusion of the pylorus). Some of the most difficult cases to deal with were the recurrent duodenal ulcers after primary excision of the ulcer and pyloroplasty. In two cases an abscess cavity as large as a hen's egg formed around the ulcerated duodenum, the entire anterior wall of the duodenum having perforated and ulcerated away. The abscess wall in these two cases was one-half inch thick; it could not be removed, and its lining had to be excochleated. A review of the histories of these patients will reveal, not only the frequent failure of conservative operations to bring about a radical cure, but will also show the frequent frightful complications that are attendant upon these conservative operations.

Of these secondary operations, we have had, in the period under discussion, a total number of 105, with twenty-two deaths, a mortality of 20.9 per cent. Strictly speaking, this mortality is not to be put down to partial gastrectomy, inasmuch as all these deaths occurred in patients who had a primary gastroenterostomy, ulcer excision, or pyloroplasty. These had failed to bring about a cure and, inasmuch as the lasting cure is the aim of the surgeon and the desire of the patient, and inasmuch as a secondary partial gastrectomy had to be resorted to before this lasting cure could be brought about, it would seem to the writer that the mortality attendant upon secondary operations is to be added to the mortality of primary gastroenterostomy, pyloroplasty, and ulcer excision, and that the sum total of this mortality should be compared with that resulting from primary partial gastrectomy.

The time that has elapsed for the observation of patients in whom a primary subtotal gastrectomy was performed is still too short to draw any positive conclusions as to lasting cure. We have, in preceding publications, insisted upon a ten-year period of observation. The cases reported in this paper have been under close observation from one to six years. We have been able to keep in touch with about 60 per cent. of our ward patients and about 80 per cent. of our private patients. The cases reported in this paper are about 50 per cent. ward and 50 per cent. private patients. Though we are not able to report, this evening, on the late results after as long a period as with the gastroenterostomies, nevertheless, we can compare the results following gastroenterostomy, *etc.*, after six years with those that have

followed partial gastrectomy after six years. Doctor Lewisohn investigated the late results following gastroenterostomy for ulcer and found them to be as follows: In 68 cases of gastroenterostomy for ulcer of the duodenum, re-examined from 4 to 9 years, 47 per cent. were completely cured; 19 per cent. had a fair result and 34 per cent. had gastro-jejunal ulcers. The diagnosis of gastro-jejunal ulcer was confirmed by secondary operation in 18 per cent. and in the remaining 16 per cent. was based on clinical symptoms and X-ray findings. In comparison with gastroenterostomy, we have had four cases of probable recurrence of ulcer in the ward patients and two cases of definite recurrence in private patients. Of the latter, one died. His history is of interest. His ulcer symptoms commenced when he was fifteen years of age. At eighteen years I performed a gastroenterostomy. After gastroenterostomy he remained fairly comfortable for about ten years and then suddenly, one night while he was free of symptoms, the duodenal ulcer perforated. This was closed by suture. Examination showed that the gastroenterostomy was sufficient and normal. Six months after the perforation, symptoms of gastrojejunal ulcer developed. This latter gave rise to repeated hæmorrhages, severe suffering and emaciation, and necessitated a partial gastrectomy about two years later. At this operation a large penetrating marginal ulcer was found. The original duodenal ulcer was healed. The gastric secretion was always hyperacid. After the last operation, he was well for about a year. Symptoms of hæmorrhage, pain, and disability then set in. After utter failure of all medical means of treatment, he had to be reoperated upon. A large perforated ulcer of the jejunum was found penetrating into the root of the mesentery and retroperitoneal tissues. Excision of this ulcer was extremely difficult. He was progressing well until a suppurative pylephlebitis developed and he died from the results of the suppurative pylephlibitis about two weeks after the last operation. At his death he was about thirty-five years old. This history is of importance as showing that the man suffered with ulcer in one form or another for a period of over twenty years. Gastroenterostomy had brought relief for a number of years but did not prevent a perforation of the original ulcer years afterward. The case is of further interest as showing the long period that elapsed (over ten years) before the formation of a gastrojejunal ulcer. On numerous occasions, we have noticed, that *when the duodenal ulcer heals after gastroenterostomy, either a new gastric ulcer* or a *marginal or jejunal ulcer forms*, and *when this last-named ulcer has been excised* and *the stoma disconnected*, the *original duodenal ulcer reopens*. So, in this patient, when the duodenal ulcer had perforated and healed, a gastrojejunal ulcer developed. The persistence of his high acidity after partial gastrectomy made him susceptible to the formation of jejunal ulcer for the operative relief of which he succumbed.

The other private patient had a simpler history. A gastroenterostomy had been done several years before for a duodenal ulcer. At the site of the new stoma a gastrojejunal ulcer developed and for the cure of this ulcer a partial gastrectomy had been done. The gastric contents remained persistently

hyperacid, and several years after the partial gastrectomy he developed a jejunal ulcer. A further resection of the stomach and resection of the jejunum and left vagus section were made. Patient made a good operative recovery. At the present time he is free of all symptoms. His gastric contents, six months after last operation, are subacid.

We are strongly suspicious of recurrent ulcer in four ward patients but are by no means sure of it. Three of these patients are able to attend to their daily work, but have occasional periods of pain. Their gastric contents all show free hydrochloric acid. X-ray examination sometimes reveals a tender stoma, and in two there seems to be a penetrating ulcer at the new anastomosis. At other times the X-ray examinations are entirely negative. Their sufferings are so mild in character that they are unwilling to be operated upon. All three maintain or have gained in weight. We class these cases amongst the recurrent ones but, as stated above, we are not at all convinced that they belong positively in this category. The fourth ward patient is put down as a recurrent case because he complains of ulcer symptoms. Objectively, neither by physical examination nor by X-ray, have we found any evidence pointing to a recurrence. His gastric contents are subacid.

Thus, out of a total of 516 cases of primary and secondary partial gastrectomies, we have but two cases of undoubted recurrence, three cases of probable recurrence, and one case of possible recurrence. All six patients have had free hydrochloric acid in their gastric contents. If all six cases are put down as positive recurrence, the percentage would be 1.1. In a similar period, I have shown from the statistics of Doctor Lewisohn, above quoted, in the same clinic, that, with the same character of patients, with the same kind of ulcers, the percentage of recurrence was 34 per cent.

There need be very little more said when these results are compared. The patients who have had a partial gastrectomy are vigorous, strong, eat all kinds of food, are able to do their work; their intestines function, for the most part, normally, and there is a percentage of recurrent ulcer of 1.1 per cent. Those who have had gastroenterostomy, *etc.*, performed never measure up to those who have had partial gastrectomy done. While some of them eat everything, the majority must be careful of their diet and the percentage of recurrence is over 30 per cent. It is such a comparison as this that confirms our belief in the value of partial gastrectomy as a cure for gastric and duodenal ulcer.

When we commenced our work on partial gastrectomy for the cure of ulcer we had reason to believe that by the removal of the antrum the gastric contents would be rendered anacid. It was thought that the secretion elaborated by the antrum stimulated the acid gastric glands to action and that the removal of this secretion would remove the motor that caused the acid glands to secrete free hydrochloric acid. We were particularly happy in our early cases to find that after partial gastrectomy gastric secretions were anacid. At that time we were using the Ewald test meal and the meal was

extracted about an hour after its ingestion. When we replaced the Ewald test meal by the fractional test meal (Rehfus), we found that gastric anacidity did not always follow upon partial gastrectomy. Dr. Eugene Klein, of our clinic, took up a careful investigation of this subject and his results are shown in the following table:

Maximum Free Acid After Partial Gastrectomy in Fractional Test Meals

	Anacid	0–20	20–50	50 and above	Number of cases
Duodenal:					
Before operation		4 per cent.	36 per cent.	60 per cent.	50
Recent	9 per cent.	9 per cent.	46 per cent.	36 per cent.	11
Old	25 per cent.	41 per cent.	17 per cent.	17 per cent.	12
Gastric:					
Before operation		28 per cent.	60 per cent.	12 per cent.	25
Recent	45 per cent.	33 per cent.	11 per cent.	11 per cent.	9
Old	100 per cent.	.....	.....	.....	3
Gastrojejunal:					
Before operation		11 per cent.	67 per cent.	22 per cent.	9
Recent	25 per cent.	25 per cent.	50 per cent.	.....	4
Old	50 per cent.	.....	50 per cent.	.....	2

("Recent," refers to cases examined immediately after operation; "old," to cases examined six months after operation; "before operation," in gastrojejunal group, refers to cases examined before partial gastrectomy.)

The results of this investigation showed us that partial gastrectomy did not always bring about an anacidity and we had long ago learned that as long as the gastric contents remained acid the possibility of recurrence existed. It will be noted from the above table that all of the gastric ulcers were followed by an anacidity of gastric contents and in no case of gastric ulcer treated by partial gastrectomy have there been evidences of recurrence. The six cases with possible recurrence referred to above have all been duodenal ulcers. It is reasonable to conclude that the higher the percentage of free acid in the gastric contents, the greater the possibility of recurrence. Patients with duodenal ulcer who have a low or moderate acidity prior to partial gastrectomy all become anacid or considerably subacid after partial gastrectomy. Thus, it is only those who have hyper amounts of acid before the operation of partial gastrectomy, that maintain this acidity after the antrum and part of the body of the stomach have been removed. It is to this class of cases that we devoted our attention, to see whether we could not render them completely anacid or markedly subacid. Doctor Winklestein approached this question in a medical way and Dr. Eugene Klein dealt with it in an experimental operative manner. Their results have been published elsewhere. We found, experimentally, that the division of the left pneumogastric nerve as it passed through the cardiac opening of the stomach rendered patients completely anacid who were highly acid prior to partial gastrectomy, and whom we had every reason to suppose would remain acid after the partial gastrectomy. Some of these patients, and there were sixteen altogether,

became anacid two weeks after the operation and the rest of them became totally anacid several months after left vagus section. None of the patients in whom a left vagus section was made died or showed any untoward results. The division of the left vagus nerve at the cardiac opening of the diaphragm can be rapidly done without any added risk and with no untoward symptoms or disturbances. We do it now regularly in all patients who have high acidity prior to operation. This question will be dealt with in subsequent publications.

Quite a number of patients who suffer with gastric and duodenal ulcer present the symptoms of vagotonia prior to any operative interference. Frequently these vagotonic symptoms are more distressing than those resulting from the ulcer. These vagotonic symptoms are not at all dependent upon the ulcers but accompany them. It is readily seen, therefore, that they are not very likely to be influenced by any of the procedures that are employed for the cure of ulcer. In our follow-up clinic we see quite a number of patients who complain of dizziness, headache, sweating of the palms, cardiac palpitation, even though they are entirely free of all gastroenteric disturbances. Tonics, roborant treatment of all kinds, and sunlight treatments are all of help in ameliorating this type of complaint. We have not seen that the patients are incapacitated from their usual occupations by the existence of these vagotonic disturbances.

In this series of 516 patients there were quite a large number who came to us in the active period of bleeding. In a considerable percentage of these cases the hæmoglobin had fallen to 20 to 30 per cent. It is not our practice to operate in the active stage of bleeding unless the bleeding is persistent and continuous. It is our practice to wait until hæmorrhage stops and then, after one or more transfusions, to proceed to operate. In three of the patients of this series we were compelled to operate because the hæmorrhages had been persistent for three weeks or more, even though the individuals were in a practically moribund condition. All three of these patients died. These three patients should be taken out of the mortality statistics because we knew in advance that death would ensue and it was only in the hope of saving a lost life that operation was undertaken. In all three of these cases operation should have been resorted to before the patient's condition became so desperate. When the patient is very anæmic prior to operation, either because of loss of blood or because of the pains and suffering and toxæmia resulting from the ulcer or from both combined, it takes a long time (six months to a year) before the anæmic condition is improved. Now and then a transfusion will help, but, as a rule, the slower building-up process by fresh air, nourishing food, heliotherapy, and tonic is more effective. For the first six months after the operation the patient seems to remain stationary. His blood-picture changes very little but once he commences to improve, his progress is rapid and steady. *We have not seen any case* of *pernicious anæmia* following *partial gastrectomy.*

Much has been said concerning the comparative results of medical and

surgical treatment for the cure of gastric and duodenal ulcer. The surgeon has been content, even to the present time, to take his cases for operation from those who have resisted repeated efforts on the part of the internists to bring about a cure and from those who have suffered from cicatricial stenoses and malformations of the stomach as the result of the healing process. The time has come when the experience of the surgeon in the radical cure of ulcer should be set side by side with that of the medical man. We believe, as do most surgeons, that the patient suffering from ulcer should have at least one thorough-going medical treatment. If this prove inefficacious, then the patient should be told that continuation of the medical treatment will serve only to relieve the symptoms, but will not be likely to effect a cure. The result of partial gastrectomy in the cure of ulcer has been carefully given in the preceding pages. It is well to glance at the late results of medical treatment. A few years ago, Dr. B. Crohn made a study of his cases in the out-patient department of the Mount Sinai Hospital, the results of which are hereby given.

Remote Results of Medical Treatment
in Percentages

Year	Cases	Period of Follow up	Cured	Impr.	Unimpr.	Oper.	Perforation	Death
1922.....	22	4 year	27.3	22.7	9.1	31.8	9.1	4.5
1923.....	17	3 year	41.2	23.5	5.9	23.5	0.	5.9
1924.....	30	2 year	56.6	10.	6.6	23.3	0.	3.3
1925.....	32	1 year	67.5	22.	9.4	1.1	0	0

A larger number of cases was analyzed by Nielsen, and the results published in the Acta Scandinavia. These results are

Ultimate Results of Medical Treatment of Gastric and Duodenal Ulcer
2½ to 20 years after discharge from Hospital. (Nielsen)

Duration of Symptoms	Permanently Cured	Permanently Cured after Relapse	Total Permanently Cured	Improved	Bad Results
Symptoms less than ½ year before treatment—30 cases..	60 %	0	60 %	16.7%	23.3%
Symptoms ½ to 1 year before treatment—24 cases.....	33.3%	20.8%	54.1%	16.7%	29.2%
Symptoms 1 to 3 years before treatment—19 cases.....	26.3%	10.6%	36.9%	21 %	42.1%
Symptoms 3 to 5 years before treatment—15 cases.....	20 %	0	20 %	26.7%	53.3%
Symptoms 5 to 10 years before treatment—37 cases.....	2.7%	8.1%	10.8%	10.8%	78.4%
Symptoms over 10 years before treatment—35 cases....	5.3%	0	5.3%	17.6%	77.1%

The consideration of these medical results by two independent investigators shows that medical treatment fails to bring about a lasting cure in a large percentage of the patients. If the results already obtained by partial

gastrectomy are further substantiated by continued observation, is it not fair to conclude that where patients have not been cured of their ulcer by one or two good medical treatments, they should be advised to undergo operation?

It is a common fallacy to believe that medical treatment of ulcer is unattended by any risk. This is not in accordance with facts. In our hospital, during a period of about ten years, about 1 per cent. of ulcer cases under medical treatment died from hæmorrhage; at least 1 per cent. died from perforation; a small percentage of gastric ulcers developed carcinoma. Quite a large percentage of patients, while under medical treatment, die from inanition, toxæmia, and renal, cardiac, and pulmonary complications. If all of these causes of death are counted up the mortality attendant upon palliative medical treatment of ulcers is considerably higher than that attendant upon the radical surgical treatment.

In concluding this paper the writer wishes to call attention to several important facts concerning ulcer. Firstly, ulcer of the stomach and duodenum is a local disease dependent upon a specific gastritis, free hydrochloric acid in the stomach contents, and a secondary infection. Secondly, a radical cure must eliminate all of these factors. Thirdly, experience has shown that partial gastrectomy, because it eliminates all of these factors, is most likely to effect a radical cure. The number of recurrences after partial gastrectomy is exceedingly small—about 1 per cent. Finally, investigation has shown that the medical treatment of ulcer is attended by just as grave risks as is surgical treatment, and, unless instituted very early, is not likely to bring about radical cure; and that when a patient has had one or two good medical treatments and has not been cured, operative procedure should be undertaken.

DISCUSSION

Dr. Harold E. Santee* reported the results of gastric resections performed in the Cornell Division at Bellevue Hospital. Of 105 cases, twenty-six are immediately eliminated as carcinoma, although not all appeared certain at the time of operation. Of the remaining seventy-nine, ten were secondary resections in the sense that previous gastroenterostomy or resection had been performed. All other cases are considered primary, whether previous operation on stomach or abdomen had been performed. It is this group of sixty-nine that he had considered, a small group, but offered at its face value.

The cases immediately divide themselves into twenty-six duodenal ulcers and forty-three gastric ulcers—a division which Doctor Santee believed should be made for the reason that a resection for an average duodenal ulcer is technically a much smaller operation than a resection for a gastric ulcer with its possible complicating features. Moreover, the age incidence in the duodenal group is thirty-three and one-quarter years as against forty-

*Meeting of the Surgical Section of the New York Academy of Medicine, March 7, 1930.

four and one-half years in the gastric group. Of the duodenal group, three died, or 11.5 per cent.—one from shock (aged twenty-seven), one from pneumonia and myocarditis (aged sixty-one), one from pneumonia and lung abscess (aged twenty-nine). Of the gastric group, seven died, or 16.3 per cent. Their average age, including one of thirty, was fifty-one years. The causes of death apparently were shock (two, aged fifty-six and forty-three), pneumonia (two, aged forty-four, with lung abscess, and aged forty-three), myocarditis (one, aged sixty-four), progressive anæmia and asthenia (one, aged fifty-five), obstructed anastomosis with secondary operation (one, aged thirty). In two of these cases, pre-operative bleeding from the ulcer played a major part in the fatal ending. The procedure was perhaps ill-chosen and unwisely executed. One would hope to save some of them now by better judgment and more available transfusion funds. This gives a mortality percentage of 14.5 per cent. for the entire group. So much, then, for statistics. It becomes evident, then, that this operation packs a potential wallop which often becomes real in the face of complicating features or increasing age. Judgment, experience and the wiser handling of patients pre- and post-operatively should materially reduce these figures. They represent, however, the work of several men and perhaps may be taken as an average in the small group of cases.

Is this operation, then, a procedure of choice in duodenal ulcer? About three years ago, Doctor Santee was practically converted to such a view by Doctors Berg and Lewisohn, abetted as they were by the Finsterers and Haberers of the profession. A number of resections for duodenal ulcer resulted. Now he feels differently. Until the cause of gastric and duodenal ulcer is definitely determined, treatment must be empirical. The most recent contribution to the specific etiology is about to be published by Saunders of the Bellevue staff, working in the Cornell Department of Experimental Surgery. With special media, he has consistently recovered from ulcers resected by Doctors Berg and Santee a non-hemolytic alpha streptococcus (not viridans, not hemolytic, not Rosenows), the specificity of which seems to be proved by its constant agglutination in small titre by the patient's blood serum. Wih this same streptococcus, typical chronic indolent ulcers have been produced in the skin of dogs. It is a significant finding and possibly points the way toward accounting for the chronicity of gastric and duodenal ulcer under medical treatment and the latency and reactivation of such ulcers under surgical treatment when stomas close or gastroenterostomies are undone. Whatever the etiology, however, gastroenterostomy presents for the properly chosen duodenal ulcer a precedure perhaps equally empiric to resection but not equal to it in mortality and attended, Doctor Santee believed, by very satisfactory results. In a recent review of 202 of their cases, such mortality was 2.9 per cent. Satisfactory results were about 85 per cent. Felter, of the Bellevue staff, in a Cornell Clinic follow-up of approximately 100 such cases done by forty-odd surgeons in twenty-five hospitals in Greater New York, finds an excellent result in 75 per cent.

and good in 17 per cent., a total of 92 per cent. of satisfactory results in that economic status and physical comfort have been reëstablished and qualitative and quantitave indigestion reduced to a minimum. All these cases were individually and personally seen, talked with, examined and fluoroscoped. In not over 3 per cent. is there a suspicion of marginal or jejunal ulcer. Personally, he believed the occurrence of the latter lesions to be not over 5 per cent. Did he believe it to be as large as quoted in some clinics, he would be conscientiously forced to give up gastroenterostomy because marginal and jejunal ulcers are miserable conditions and their cure attended by grave risk.

Gastric ulcer as considered against duodenal ulcer presents a different problem. Its complicating features as to position, size and penetration, its potentialities or realities as to malignancy, combined with the fact that local excisions and gastroenterostomies are in no way as satisfactory as in duodenal ulcer, lead him to accept resection as the operation of choice. The wise man, however, will recognize his own limitations in the face of technical difficulties, such as a high ulcer on the lesser curvature, and may very well in the best interest of his patient sacrifice the ideal procedure to the immediate welfare of such patient.

As to a statistical study of late results he will offer little at this time. One subtotal resection in which the pyloric ring was left in developed a definite jejunal ulcer. Through Doctor Berg's courtesy, he later saw him make this resection more subtotal. Two cases, one a chauffeur and one a colored cook, have been much distressed by an absolute lack of hunger for almost a year. It particularly peeved the colored cook. Others have complained of fullness after eating too rapidly or too much. Considering the mechanical conditions present, however, after resection, he has been surprised at the small number of such complaints. If he might be permitted an expression of opinion on what he acknowledges to be insufficiently studied data, he would say that the resected cases present the happier and better cases at the return clinic if they arrive there and that this operation is the operation of choice in gastric but not duodenal ulcer.

Dr. John Douglas remarked that Doctor Berg had presented a very convincing argument for the radical operation for the cure of gastric and duodenal ulcers. His argument is based primarily on three ideas: first, that operations other than a subtotal gastrectomy are ineffectual in the cure of gastric and duodenal ulcers; second, that the danger of a radical operation is not sufficiently great to be a contra-indication to its use; third, that subtotal gastrectomy is a cure.

Considering first the mortality and danger of the operation, Doctor Berg has presented a very low mortality rate for such an extensive operation. Certainly the mortality rate for gastric resection by most other surgeons is larger than Doctor Berg's statistics show. Perhaps this may be due to Doctor Berg's dexterity. But a gastric resection, where the stomach

is free and uninvolved and the lesion present a small duodenal ulcer, would of course give a smaller mortality than where other surgeons are performing a group of these operations for gastric ulcer, which may be high on the lesser curvature, have formed adhesions to the pancreas, and caused deformity of the stomach, all of which greatly increases the difficulty.

As to the poor results of the less radical operations which are reported from many foreign clinics as well as from Mt. Sinai, it has been the belief in St. Luke's Hospital that the less radical operations have not shown such poor results. The speaker had occasion to check up on the follow-up of a group of cases that were operated on in St. Luke's Hospital previous to the year 1925, so that in none of these cases is the follow-up less than five years. These operations were performed by the different surgeons on the staff and the patients have recently been checked up on in order to determine their present condition. In this group, while the statistics and classification are as yet incomplete, there were 204 duodenal ulcers—excluding perforated cases—a simple posterior gastroenterostomy having been done on 135. Of these 135, four died, making the mortality rate 2.9 per cent. They had been able so far to get a follow-up for a period of five years or longer on only sixty-five of these cases. Of these sixty-five, the result was satisfactory in fifty-eight, giving a good result of almost 90 per cent. There were nine deaths in the total of 204 cases (without perforation), making the mortality rate 4.4 per cent. for all operative procedures. Including the cases of perforation, the mortality rate was 8.9 per cent. The less satisfactory results in the duodenal cases were in those where a pyloroplasty of some type had been performed or a simple closure of a perforation done. Frequently, this pyloroplasty was done as part of an operation for a perforated ulcer. In the 150 gastric ulcer cases they were able to get a five-year follow-up on only sixty-three cases. In thirteen of these, the result was unsatisfactory, which would leave only an 80 per cent. good result and the mortality higher. The mortality showed thirteen deaths in 146 cases where death did not follow an operation for perforation, or 9 per cent. This included thirty-six resections of some part of the stomach.

Now as to statistics. In going through these cases it has been exceedingly difficult to determine how to qualify cases. Many cases are relieved of any and all gastric symptoms. Some have symptoms unless a careful diet is followed. Others suffer distress only after alcoholic or dietary indiscretions that even a normal stomach could not stand. Furthermore, in the follow-up clinic, it has been observed that many patients, several years after their operations, during which time they have been relieved of symptoms, come to the return clinic with very bad teeth or other focal infection, and it is my belief that so long as a condition of that kind exists even a gastrectomy may result in a return of symptoms.

One of Doctor Berg's contentions, as well as of others advocating a radical operation for an ulcer of the stomach or duodenum, has been the frequency of gastrojejunal or jejunal ulcers. Doctor Douglas had been

able to find in the records at St. Luke's Hospital fifteen of these cases. In many of these the primary operation was done elsewhere. In some the operation was done at St. Luke's Hospital. In five of these cases no operation was done and the diagnosis has been somewhat questionable. One of these cases, where there was a gastrojejuno-colic fistula, had had a subtotal gastrectomy done in one of the large clinics by one of the best surgeons in the country. The operation had been most radical. The patient died in St. Luke's Hospital without an operation for his fistula and the condition was confirmed at autopsy. A similar case of recurrence occurred after resection done at St. Luke's Hospital. Many other cases have been reported of marginal ulcer after gastric resection, although he believed it is Doctor Berg's contention that these were not subtotal gastrectomies but pylorectomies. It would appear, however, that in a few cases recurrence of ulceration may occur no matter how radical an operation is done.

He believed it to be an unfortunate fact that this contention among surgeons, of the inadequacy of less radical operations and the danger of more radical operations, has caused many medical men to distrust all surgery for gastric and duodenal ulcers. For while a very fair percentage of gastric and duodenal ulcers can be cured by non-surgical measures, so that careful medical treatment should always be tried first, there still are many cases which can be relieved and cured only by surgery. And, while one admits the strength of Doctor Berg's argument, one still feels that he would prefer to have the less radical operation done in his own case for a duodenal ulcer, rather than a subtotal gastrectomy. In cases of gastric ulcer, because of the real danger of carcinoma being present and because of more unfavorable results by less radical operations than in duodenal ulcer, he thought a subtotal gastrectomy had its real and definite place.

Dr. Seward Erdman felt that his own personal experience with partial gastrectomy was so limited, and the total of such cases on the Second Surgical Division of the New York Hospital was so small in comparison with the 515 cases reported by Doctor Berg, that he would not attempt an analysis of his cases, other than to say that the mortality at the New York Hospital was very much higher than that reported by Doctor Berg. Therefore his discussion would consist chiefly in challenging the theory that partial gastrectomy should be the standardized operation for duodenal ulcer; also in attempting to refute certain other statements made by Doctor Berg on this and on previous occasions.

1. Results of gastroenterostomy for duodenal ulcer.—From Doctor Berg's service at the Mt. Sinai Hospital, Lewisohn, in 1925, reported 34 per cent. of gastrojejunal ulcers, and only 50 per cent. cures, following gastroenterostomy for duodenal ulcer and pyloric ulcer, during the years from 1915 to 1920.

This unique finding is given as a reason for abandoning gastroenterostomy and adopting subtotal gastrectomy.

How widely different has been the experience of a number of other surgeons of this country and of England, is shown by the end-results in 234 traced cases of duodenal ulcer treated by pyloroplasty or gastroenterostomy, reported by Finney (ANNALS OF SURGERY, November, 1929), in which series 90 per cent. of those who survived operation were well or improved for periods of from two to twenty years. He also states that 5 per cent. is a conservative estimate of the occurrence of marginal and jejunal ulcers after gastroenterostomy.

The late Doctor Peck, of New York, reported over 80 per cent. good results from gastroenterostomy; Walton and Moynihan each report over 90 per cent. good end-results, as do the Mayos.

By all these surgeons, the occurrence of secondary ulcers and marginal ulcers runs between 2 per cent. and 5 per cent., following gastroenterostomy.

The practical agreement of these reliable surgeons that gastroenterostomy for duodenal ulcer gives good results in nearly or quite 90 per cent., serves to greatly weaken the argument by Doctor Berg in favor of gastrectomy, based on his own singularly unfortunate results with gastroenterostomy.

2. Operative mortality.—Doctor Berg has chosen to lay much stress on his low operative mortality following partial gastrectomy and for his purposes he classifies the operative deaths as follows: in a total of 515 gastrectomies, there were thirty-two deaths following so-called primary operations, twenty-two deaths following secondary operations, and four deaths in a small group of nearly total gastrectomy.

These fifty-eight deaths in a series of 515 cases, give 11 per cent. operative mortality, or over 10 per cent., even if the four deaths in the more radical resections are omitted.

Doctor Berg has shown a table of operative mortality in series of gastroenterostomy cases by other surgeons, to contrast with his 6.7 per cent. mortality in the selected group of primary partial gastrectomies.

He cites the following mortalities following gastroenterostomy: Finney, 16 per cent.; Peck, 10 per cent.; Mason, 6.9 per cent.; Pool, 7 per cent., but these men all included primary and secondary operations without distinction, and, at least in Finney's and Pool's series, represented operations by a large number of different surgeons. Finney included all deaths occurring within six months after operation.

A fairer estimate of the relative mortality of gastroenterostomy and of gastrectomy is afforded by the reports from the same individual surgeon; thus, Moynihan had 1 per cent. mortality in gastroenterostomy—indeed, 500 consecutive cases without a death—but finds the mortality after gastrectomy runs from 5 to 10 per cent.

Others, such as Balfour, Mayo, and Walton, who had under 2 per cent. mortality from gastroenterostomy, acknowledge 10 per cent. or five times as great mortality after gastrectomy.

In general, among surgeons who speak our language both literally and

surgically, one finds that gastrectomy has a very much larger mortality, where all deaths are included.

3. Does partial gastrectomy produce "total and permanent anacidity"? Such was the claim made by Doctor Berg in a talk given by him several years ago in the Academy of Medicine on Forty-third Street.

We believe that neither Doctor Berg nor Doctor Lewisohn would adhere to such a claim at the present. Indeed, from Doctor Berg's service at the Mt. Sinai Hospital, Klein reported in the ANNALS OF SURGERY, July, 1929, that of the cases examined after gastrectomy for duodenal ulcer, 17 per cent. showed persistent "hyperacidity," and only one-quarter are anacid.

The ordinary Ewald test meal is no longer considered reliable. E. Perman (Zentralbl. f. Chir., 1927), made interesting observations on cases after gastrectomy for ulcer, but where a temporary gastrostomy had been added after the Witzel method. In five such cases after a Billroth No. 1 operation, all five showed free hydrochloric acid, one in slight amount and four in large amount. In fourteen cases following Billroth No. 2, three showed anacidity, four showed small amount of free acid and seven showed approximately normal acidity. At the same time he examined fourteen cases of Billroth No. 2 without Witzel fistulæ, using a test breakfast, and found nine cases anacid, and five with small amounts of acid. He concludes that after Billroth No. 2 operations the test breakfast is misleading probably because contents leave the stomach almost immediately, whereas through the Witzel fistula there is little admixture with the duodenal content.

Therefore even if only 17 per cent. of cases remain hyperacid after gastrectomy, as admitted by Klein, one cannot claim immunity from secondary ulcers if acidity is the cause.

4. Does gastrectomy grant immunity from subsequent ulcer formation? Several years ago, in the old Academy of Medicine, Doctor Berg stated that he was obtaining 100 per cent. cures, based on his experience with his earlier gastrectomies.

Balfour, in 1928, reported that he had already operated upon twenty-eight cases of recurrent and marginal ulcers following gastrectomy for ulcer.

Moynihan (Brit. Med. J., 1928), had collected from literature 100 cases of jejunal ulcer after gastrectomy.

H. K. Louria, of Brooklyn (S. G. O., October, 1928), reports on 179 gastrectomies for ulcer, operated upon in Haberer's Clinic, and followed for from one to three years. About one-half of these were examined at the clinic and one-half reported by letter. Of the 107 cases of gastrectomy for duodenal ulcer, only 83 per cent. were classed as good results.

Therefore, the facts are that marginal and jejunal ulcers may and do occur even after the partial gastrectomy.

5. Duodenal ulcers and gastric ulcers are put in the same classification, by Doctor Berg, who adds that "the life history is the same."

Whatever truth there may be in this contention, so far as the etiology and pathogenesis is concerned, the similarity ceases when one considers the

much-discussed question of the possible development of cancer on an ulcer base, for such a cancerous change is never encountered in duodenal ulcers, although it does occur in a small percentage of ulcers of the stomach.

Regarding the frequency of such cancer in cases of gastric ulcer, there is wide divergence in medical opinion, although this possibility advanced by Rodman many years ago is often given as the reason for choosing gastrectomy for ulcer of the stomach.

If the development of cancer on an ulcer base is to be regarded as a pathological sequence and not a mere coincidence, then the site of election for cancer should correspond with the site of election for ulcer of the stomach, but apparently this is not so.

Moynihan in a series of 2000 gastric ulcers studied, found less than 3 per cent. at the pylorus or within one and a half inches thereof, the vast majority being on the lesser curvature.

On the other hand, Welch, quoted by Ewing, in a study of 1300 cases of carcinoma of the stomach, found 60 per cent. to be located in the pars pylorica, 20 per cent. on the lesser curvature and 20 per cent. on the greater curvature.

From these two studies it therefore appears that 60 per cent. of cancers occur in that portion of the stomach where only 3 per cent. of ulcers are found.

Finally we would quote Moynihan (Brit. Med. J., 1928): "Gastrectomy for duodenal ulcer is neither safe nor simple and does not give better end-results than gastroenterostomy. The worst of gastroenterostomy is known and the best is unsurpassable. We have yet to learn the worst of gastrectomy and what we know is unfavorable enough."

We admit that Doctor Berg has shown "how" gastrectomy may be performed for duodenal ulcer, but we remain unconvinced as to "why" it should be done.

DEFORMITIES AND OBSTRUCTIONS OF THE STOMACH AND DUODENUM

By Addison G. Brenizer, M.D.
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The main causes of deformities and obstructions of the stomach and duodenum are: (*a*) ulcer; (*b*) cancer; (*c*) gall-bladder; (*d*) periduodenal membranes and bands; (*e*) diverticula of the duodenum and (*f*) compression of the duodenum by the superior mesenteric or median colic arteries.

There is a well-defined pathological anatomy and disturbed function produced by these conditions, exhibiting them clinically and by X-ray studies in at least 84 per cent. of cases of ulcer and cancer, and in 87 per cent. of all cases combined and finally marked lasting benefit to the patient from proper choice of surgical procedures in about 90 per cent. of cases. There remains just as definitely about 13 per cent. of confused diagnosis and 10 per cent. of patients who are not altogether comfortable due either to the failure of the operation or to improper choice of the appropriate surgical procedure. Although a confused diagnosis in 13 per cent. of cases still exists in spite of elaborate clinical, X-ray and laboratory studies, and a failure to render the patient symptom-free in about 10 per cent. cases by the use of the various operative procedures, it is at the same time made evident that these percentages may be reduced by persistent clinical and X-ray studies, with elimination of other simulating conditions, and a developing surgical judgment of the proper choice of the basic operations now described. In other words, the armamentarium for diagnosis and treatment is now adequate if properly employed and interpreted. In reality even a "chronic ulcer" of the stomach and duodenum is a visible and palpable lesion present for months or years, though varying from time to time in its destruction of tissue and stubborn repair; there is a crater of varying size; the ulcer involves at least the muscle coat and sometimes all coats; the adhesions of the ulcer base to the neighboring structures prevent a gradual perforation and considerable deformity and constriction at the site involved.

The widely discrepant statements made by those medical men, physicians, surgeons and röntgenologists who have taken part in the many symposia and discussions of the subjects of gastric and duodenal ulcer, especially the contrary views of medical and surgical treatment, and more important the problem of carcinomatous degeneration at the edge of simple chronic ulcer, are most discordant and confusing to the average physician and surgeon, since the care of the patients and the responsibility of their future life and comfort are not confined to the "centers," from where most data and statistics on the subjects are assembled and compiled for discussion.

The writer accepts and grants that acute gastric and duodenal ulcers are

the province of the physician and not the surgeon, except when accompanied by recurrent hæmorrhage and perforation, and believes that hæmorrhage and perforation rarely take place in acute ulcers but usually in the exacerbation of a persistent callous ulcer, when the scar breaks down and a dormant ulcer is aroused to activity likely by revived infection. The writer does not know the percentage of carcinomatous change in simple chronic ulcer. He neither accepts the high percentages reported from the examinations of specimens from gastrectomy performed in the early stages of carcinoma as the only trustworthy evidence of the incidence of cancer in ulcer, nor the opinions of surgeons and röntgenologists that the incidence in simple ulcer is rare and that most ulcers accompanied by malignant changes are in reality and from the beginning of development ulcerated carcinomata. The writer has also carefully noted the location of prepyloric ulcer (in the cap), post-pyloric ulcer (in the antrum) and corporic ulcer (in the corpus, along the area of lesser curvature supplied by the left gastric artery) and has remarked on the apparent fact that his cases of cancer mostly did not give a history of previous ulcer and that the protractive cancerous ulcer not infrequently occurred in the fundus and near the greater curvature, outside the ulcer area. On the other hand the writer is anxious as to the destiny of any patient suffering with gastric ulcer, whether the possibility of change from simple ulcer to malignant is great or whether an appreciable percentage of ulcerative lesions of the stomach are carcinomatous. The possibility of malignancy, hæmorrhage and perforation in chronic duodenal ulcer give him deep concern and direct his attention to the resection of the ulcer.

Cole's conclusions, from the viewpoint of a röntgenologist are interesting: "Ulcers that occur nearer the greater curvature than the lesser should be considered ulcerations in carcinomatous areas and not benign ulcers."

"Any ulcer that increases in size, after the initial avulsion of the crater, should be considered malignant, or at least not a simple or benign type of ulcer. This increase in size must be determined by comparing röntgenograms made at the end of one week in bed, two weeks in bed and if necessary at the end of a third week in bed, care being taken that the patient is in the same posture during each examination." In other words, according to Cole, practically all benign ulcers in the corpus and in the antrum occur along the lesser curvature. He has never seen one that was not benign; thirty-six cases of ulcer of the corpus healed under medical treatment. In only one instance could the second ulcer have been a recurrence rather than a new ulcer. In every instance where a subsequent ulcer developed, the subsequent ulcer healed under medical treatment with as great or even greater rapidity than the original ulcer. Duodenal ulcers, or post-pyloric ulcers are practically never malignant, though so reported. One case in my series was so reported but time has proved the pathological diagnosis wrong. This report embraces 108 cases with four deaths; one of the deaths two years after operation from a cancer imposed upon a gastric ulcer which was bleeding at time of operation, but was not found. The bleeding stopped after a gastro-

enterostomy; the other death was in the case of an old woman who had been bedridden for years with rheumatism and a very bad heart which at times decompensated; she had a perforation of a chronic gastric ulcer on the posterior surface of the stomach near lesser curvature into the pancreas, and, after resection of the ulcer and closure of the pancreas, she died on the table before the wound was closed. Two cases of carcinoma with resection of stomach, both within eighteen months from metastasis. (This series of 108 cases represents only a part of my work, since my records prior to 1922 were accidentally destroyed and certain protocols were lacking in sufficient data. While these cases are consecutive and not selected they are interrupted by other such cases where the records were incomplete.)

Using fifty of the above cases where the data was complete in every respect of clinical findings, X-ray studies and "follow-up," I have chosen the following data:

1. Ulcer or cancer confirmed clinically, confirmed by X-ray, found at operation, thirty-seven cases. Nineteen of these cases were carcinoma of the stomach, one case linitis plastica, nine were exploratory operations and nine were resections. Of the nine resections two are now dead from metastasis within eighteen months; of the nine exploratory operations all but one case is now dead within fourteen months. It will be noted that in accepting mortality in only those cases where operation was directed against the lesion itself is the death reported. It will also be noted that in all operations but one case failed to leave the hospital, and that case from heart failure on the table.

2. Ulcer confirmed clinically, not confirmed by X-ray study, found at operation, two cases. One of these was a perforation after negative X-ray study following three Sippy treatments of eight weeks each; the other was an ulcerative carcinoma with loss of forty-three pounds. Last case possibly carcinoma from the beginning, in early stage.

3. Ulcer confirmed clinically on account of voluminous hæmorrhage, not confirmed by X-ray, not found at operation, three cases. Two of these cases remained well following gastroenterostomy, the third case died two years later of carcinoma of stomach. Last case carcinoma on ulcer base.

4. Ulcer not confirmed clinically, found by X-ray, not found at operation, five cases. Two of these cases were an adhesive gall-bladder, one with stones bound down tight to the duodenum and a portion of the duodenum puckering between the adhesions, thus producing the artefact of an ulcer. One X-ray man was sure of an ulcer in one of these cases, with slow perforation to account for the pain, vomiting, distention, temperature and leucocytosis; another was doubly sure, even after the operation for liberation and removal of an acute cholecystitis. The third case was a large tuberculous ulcer near the hepatic flexure with surrounding adhesions and a very spastic duodenum, relieved by a colectomy. The fourth case was an obstruction due to adhesions and kink at the duodenojejunal junction and this is the case of duodenal obstruction on which a gastroenterostomy was wrongly done, followed by a

so-called "vicious circle" after operation. The fifth case was a very high lateral cecal and colic appendix with numerous adhesions pulling downward and outward on the duodenum.

5. Ulcer not confirmed clinically, not confirmed by X-ray, not found at operation, three cases. Two of these cases showed retrocecal appendices with wide spread adhesions in region of cecum and ascending colon. The third case showed the same thing with a markedly dilated cecum adding weight to the pull of the adhesions; this cecum was plicated and fixed to abdominal wall.

Other cases simulating gastric or, more commonly duodenal ulcer, either clinically or by X-ray study or both, but by persistent study finally diagnosed accurately and properly treated:

(1) Adhesions from gall bladder, cleared up by gall bladder visualization.

(2) Supra-mesocolic periduodenitis with membranes and bands.

(3) Duodenal diverticula.—One case gave at one time typical symptoms of duodenal ulcer, at another of cholecystitis, at another colitis with gas, soft stools or diarrhœa with mucus. This case was diagnosed by Doctors Lafferty and Phillips and Doctors Shull and Fetner, local röntgenologists, as spastic colitis; by Dr. Fred Baetger of Baltimore, appendicitis with duodenal spasm; by Dr. Pancoast of Philadelphia, adhesions from cholecystitis, and the following are the conclusions of Lewis Gregory Cole after a most elaborate and protracted X-ray study:

"From a study of those röntgenograms, I believe one is justified in making a negative diagnosis of cancer and ulcer of the stomach and a negative diagnosis of ulcer of the cap. There is no pyloric stenosis, no functional gastric retention—in fact the stomach empties more rapidly than usual. There is apparently some irritation, as there is considerable tendency to spasm of the cap and at times, the peristalsis of the stomach is exceptionally vigorous."

"There is a diverticulum of the first part of the descending duodenum." (This diverticulum was never found before in the several X-rays taken. Was it acquired or was it always present during these former studies?) "This lies to the left of the duodenum and apparently anterior to, and in close relation to, the junction of the common bile duct and pancreatic duct."

"I find no evidence of calcified gall-stones. The gall-bladder did not fill with the dye, although this was given orally on two successive days. In our experience this is quite positive evidence that the gall-bladder is diseased."

(What relation does the diverticulum bear to failure of the gall-bladder to fill? Located as it is in close relation to the junction of the common bile duct and pancreatic duct, what would be the difficulties of satisfactory removal at this location and if removed the chances of further obstructing the ducts, and, finally, what are the dangers of such diverticula beyond a causative agent in the patient's discomfort?)

"I believe one is justified in making a negative diagnosis of a diverticulosis of the lower descending colon and the sigmoid colon. There is no evidence of diverticulitis. The appendix is patent, almost six inches long, and apparently contains several small fecaliths. I would consider this a pathological condition of the appendix but I do not believe it is by any means

a surgical condition. There is apparently a congenital veil or band of adhesions in the right hypochondrium which involves but does not obstruct the hepatic flexure of the colon."

(This patient with unfilling gall-bladder, duodenal diverticulum, pathological appendix and hepatic adhesions remains unoperated on, relieved of the fear of perforating ulcer and ruptured appendix. What surgeon could resist operation on this case!)

A second case, sixty-eight years old, who forty years ago had several attacks of pain, nausea, gas and soft stools which was diagnosed "bilious colic," for he was given calomel and relieved. During such an attack eighteen years ago, he overheard the uncertainty of diagnosis and suggestion of exploratory operation made by the consulting surgeons and he left the hospital. To this day he occasionally has a little nausea and soft stools, quickly relieved after an oil purge. His physical findings are practically negative. X-ray studies showed that there is present a diverticulum involving the terminal portion of the duodenum which is smooth in outline, freely movable and not tender to palpation; and the barium meal was seen to enter and leave the diverticulum during fluoroscopic examination. The six hour picture shows a small residue in the diverticulum after the stomach and duodenum had emptied.

(4) Duodenal obstruction.—Eleven cases, ten operative. Diagnosis missed in one case.

(*a*) Due to inframesocolic adhesions, five cases. The diagnosis was suspected clinically and made by X-ray study in all five cases.

Three of these cases were relieved by duodenojejunostomy and one by gastroenterostomy after taking down the duodenojejunal angle and one by liberating the periduodenal adhesions.

(*b*) Due to compression of the arterial pedicle, two cases. One relieved by duodenojejunostomy, the other by postural treatment both during acute attacks and afterwards.

(*c*) Due to diverticulum near duodenojejunal junction by removal of diverticulum.

(*d*) Due to developing obstruction from periduodenitis and ulcer below the bulb, with hæmorrhage from ulcer, relieved by gastroenterostomy.

(*e*) Due to nephocoloptosis: Relieved by the Longyear operation. Second case relieved by resection of prolapsed megalocecum and ascending colon.

It will be noted out of the fifty cases cited above that the diagnosis was suspected clinically fifty times and confirmed by X-ray study and operation or both forty-two times; and that the X-ray study corresponded with the clinical impression and operation forty times. In other words the clinical diagnosis was 84 per cent. accurate and the X-ray study was 80 per cent accurate.

In the group, "other cases simulating gastric and duodenal ulcer," the X-ray study was about 90 per cent. accurate and cleared up a very speculative clinical impression. Of the eleven cases ten were accurately diagnosed and ten confirmed by operation and markedly relieved. These data in sixty-one cases would indicate that an accurate diagnosis, by employing history, clinical and X-ray studies, can be made in 84 per cent. of cases of ulcer and cancer of the stomach and ulcer of the duodenum (fifty cases) and in ninety of

duodenal obstruction. That a presumptive diagnosis where either clinical or X-ray examinations are at variance can be made in about 87 per cent. of cases. That an accurate diagnosis cannot be made from the combination in about 13 per cent. of the cases and that the gall-bladder, appendix, diverticula, periduodenitis and arterial compression of the duodenum will usually explain the condition in these cases. The following operations have been employed in these 108 cases:

(*a*) *Gastroenterostomy.*—In about 30 per cent. of these cases there has not been complete relief of symptoms. Most of the stomachs in those not relieved have emptied very rapidly, at times about as rapidly as the barium could be given and there has been complaint of diarrhœa and gas and some nausea and vomiting. One case particularly who had a gastric retention and markedly dilated duodenum, received the anastomosis at the duodenojejunal junction, after severing the ligament of Trietz and her stomach and duodenum empty as fast as the barium can be swallowed, faster than after a gastric resection, she still has attacks of nausea and voluminous vomiting. One case died two years later of carcinoma of the stomach not found at operation and therefore not resected. There has been no recurrence of hæmorrhage, no perforation and little or no pain in the epigastrium or right hypochondrium after these gastroenterostomies.

(*b*) *Gastroenterostomy.*—After resection of the ulcer. These patients have been free of symptoms except those due to too rapid emptying of the stomach. One case died on the table after separation of the ulcer from the pancreas with resection of the ulcer and closure of the pancreas. This was the case of rheumatism with a once decompensated heart.

(*c*) *Pyloroplasty and resection of the ulcer.*—All these cases have been completely relieved and remain symptom free except two cases, where the ulcer has recurred; one having recurrence of hæmorrhage, the other a perforation. Both of these cases studied after the first operation, showed considerable dilatation of the duodenum, which dilatation and partial obstruction, I think contributory in the re-formation of ulcer. At the second operation for perforation, the cauterization and closure of the perforated ulcer was followed by gastroenterostomy. This I have done several times when the duodenum through closure was markedly encroached upon, with perfect result. I feel sure that in case of dilated duodenum and perforation a duodenojejunostomy would prevent recurrence of these ulcers if this operation were practicable at the time or later on. X-rays following pyloroplasties are most confusing.

(*d*) *Resection of pylorus or stomach and type of Billroth No. 2.*—Two of these resections have been done for ulcer of the stomach, one showing carcinoma on ulcer base. They are both perfectly well. Seven have been done for carcinoma of the stomach, two dying in fourteen and eighteen months respectively from metastasis, the other five cases comfortable and in good health. These cases eat full meals, show a compensatory dilatation of the remaining stomach and control of emptying at the anastomosis between stom-

ach and intestine equal to if not more effective than 30 per cent. of the gastroenterostomies.

(*e*) *Resection of ulcer.*—Only in three cases have I simply resected the ulcer without combination with pyloroplasty or gastroenterostomy, except in cases of acute perforation, and even in these cases of acute perforation, those combined with gastroenterostomy, thus also relieving causative conditions and offering free drainage of the stomach have done best. In many cases with dilated duodenum and ulcer, duodenojejunostomy preceding resection would serve the purpose better than gastroenterostomy.

(f) Duodenojejunal anastomosis.—In six cases of obstructed and dilated duodenum, due to fixed obstruction at the last portion of duodenum or duodenojejunal junction, I have seen no more brilliant results in the whole domain of surgery than the relief, if not cure, brought about by duodenojejunostomy, except in the one case, where through my enthusiasm in relieving obstruction I did an anastomosis between the liberated duodenojejunal angle and the stomach. This is the case cited above with the extremely rapidly emptying stomach and duodenum, so extreme until the coils of the small intestine are made to take too voluminously the onrush of stomach contents with a resulting reverse peristalsis felt from cæcum upward and vomiting. Three more cases of duodenal obstruction were relieved by resection of a ptosed megalocecum and ascending colon, Longyear's suspension of the kidney, and removal of a diverticulum at the duodenojejunal junction. Still a final case of arteriomesenteric obstruction of the duodenum was immediately relieved of pain and voluminous vomiting by merely turning her on her stomach and elevating the foot of the bed.

(I shall elaborate deformities and obstruction of the duodenum in another paper.)

(*g*) *Duodenostomy.*—One case to give rest to the stomach and for duodenal feeding in a case of linites plastica, where the passage of a duodenal tube was impossible on account of the thickened and contracted stomach.

(*h*) Other operations, on account of mistaken diagnosis, such as appendectomy and cholecystectomy, usually with relief.

It is rather definitely clear from the above remarks under operative procedures that the best results have been obtained where the ulcer or cancer was resected and where obvious obstructive conditions of the stomach and duodenum have been relieved by proper drainage of the canal, necessary even after resection of the ulcer.

About a half of a century has elapsed since the foundation of gastric operations and yet hardly a single revolutionary method has been developed since that time. Technical modifications and improvements have been exposed, but the principles of enlarging the pyloric orifice as laid down by Heineke-Mikulicz, the gastrointestinal anastomosis of Woelfer and the gastric resections of Billroth remain the basal procedures. It is likely that none of these operations or their modifications has more than a mechanical action beyond the removal of the growth and that no enduring physiological basis

has been developed beyond the drainage of the higher into the lower portion of the gastrointestinal tract and that this principle of relieving stasis satisfies all surgical requirements and gives when clearly indicated satisfactory results.

In support of this last statement are the far more brilliant results in obstructive cases of ulcer and cancer, by gastroenterostomy, even when the emptying of the stomach is far too rapid and the remarkable results of duodenojejunostomy in duodenal obstruction. A number of the cases of ulcer of the duodenum with dilatation of the duodenum would likely be more effectively and permanently relieved by duodenojejunostomy, preceding resection of ulcer or pyloroplasty or following closure of perforated ulcer of duodenum, and in case of recurrence of duodenal ulcer and perforation. The substitution of duodenojejunostomy for gastro-enterostomy would drain the dilated duodenum, preventing stasis and pressure, more directly and preclude the too rapid drainage of the stomach, and thus prevent the untoward results of gastroenterostomy.

(The choice between gastroenterostomy and duodenojejunostomy will be pointed out in more detail and with more definite indications in a paper on "Deformities and Obstruction of the Duodenum" and Duodenojejunostomy.)

A more vital question even than the choice of the proper operation is the question whether or not to operate at all.

If we can take Cole's word for it, practically all ulcers of the stomach occur in the corpus and antrum, along the lesser curvature and all these ulcers are benign; all duodenal or post-pyloric ulcers are benign. In thirty-six consecutive cases of corporic ulcer, all healed without perforation, and in only one instance could the second ulcer have been a recurrence rather than a new ulcer. In every instance where a malignant ulcer developed, the subsequent ulcer healed under medical treatment with as great or even greater rapidity than the original ulcer. On the other hand one of these cases perforated three days after the third Sippy treatment of eight weeks each and an ulcer the size of a half dollar with perforation size of a dime was found in antrum on anterior surface. He has remained well three years after cauterization closure of ulcer and gastroenterostomy. This was a benign ulcer.

Cole further concludes that any ulcer that increases in size after the initial avulsion of the crater should be considered malignant or at least not a simple or benign type of ulcer; and ulcers that occur nearer the greater curvature than the lesser should be considered ulcerations in carcinomatous areas and not benign ulcers. In the case just cited the large ulcer located on the anterior wall of antrum near the pyloric canal never healed, was not obstructive, perforated and remains well three years following cautery excision, closure, gastroenterostomy. Therefore with ulcer outside ulcer area, he should have received gastrectomy before perforation. Two other cases with ulcer in this region and where gastrectomy was done were carcinoma and a fourth case of a man fifty-two years old with persistent vomiting, extreme reduction in weight and color, with large mass nearer lesser curva-

ture but almost entirely obstructing stomach, and glands along lesser curvature, a palliative gastroenterostomy was done with diagnosis of inoperable cancer. Two years later, with a gain of sixty pounds, this man came by to thank me for his cure. At operation one of the glands along lesser curvature should have been removed for examination by frozen section as aid in diagnosis between inflammatory gland and metastatic gland.

Cole reports eleven cases of corporic ulcer treated with gastric resection; six lived to leave the hospital and five died while in the hospital. Of the nine cases of gastrectomy reported in this paper, all left the hospital, two dying, after a year, of metastasis. All have maintained a satisfactory gastric function, even the ones who died. Why this enormous difference in mortality?

The following conclusions in projecting operation are justified:

(1) All ulcers occurring in the antrum and corpus along the lesser curvature are benign.

(2) All ulcers outside this ulcer zone are malignant.

(3) Obstructive ulcers along the lesser curvature showing inflammatory lymph glands may heal without gastrectomy.

THE END RESULTS IN FIVE HUNDRED CASES OF CHOLECYSTECTOMY*

By Robert L. Sanders, M.D.,
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A certain amount of confusion and chaos has existed in the minds of the laity and many physicians regarding the benefits derived from the removal of the gall-bladder. This study has been made in order to evaluate the results obtained after cholecystectomy. During the last eight years, 1800 cases of cholecystitis, recorded either as a primary or secondary diagnosis, have been examined in The Polyclinic. About 30 per cent. of the patients have been operated on. Many others were advised to avail themselves of surgical treatment but for various reasons declined.

Clinical Data.—A wide variation of ages may be noted in this series. The youngest patient was a girl, aged four years, who was brought to the clinic on account of abdominal pain, with nausea and vomiting, of three days' duration. A mass that was interpreted as the result of intussusception was found in the right upper quadrant of the abdomen. At operation this proved to be a large cystic gall-bladder without stones. After cholecystectomy recovery was prompt and the child has remained well more than six years. The oldest patient was a woman, aged eighty-three years, who had been ill at intervals for more than forty years. The acute cystic gall-bladder, about twenty centimetres in length, presented as a large tumor extending down to the brim of the pelvis. After cholecystectomy under local anæsthesia the patient's recovery was rapid and satisfactory. She has been in good health more than two and a half years. The average age of the series of 500 patients operated on was forty-three and eight-hundredths years. This is in contrast to reports several years ago when the average age was much more. With the increase in diagnostic accuracy, more and more cases of disease of the gall-bladder will be found in young persons.

Sixty-nine per cent. of the series were females and 31 per cent. were males. Deaver's adage of "female, fair, fat and forty" as suggestive of cholecystitis has much truth in it. Pregnancy probably plays a definite part in the etiology of the disease. The average weight was 145.5 pounds. Many of the patients weighed less than 100 pounds.

Epigastric pain of some degree, such as fullness, gas or bloating, was the chief complaint in 78.2 per cent. "Bilious" or gall-stone colic was noted in 59.2 per cent.; however, stones were found in only 40 per cent. of the gall-bladders removed, showing that typical attacks of pain may be precipitated in many cases of non-calculus cholecystitis. Qualitative food dyspepsia was noted frequently and when present was a valuable symptom in the diagnosis of cholecystic disease. A history of jaundice was obtained in 23 per

* Read before the Pan-American Medical Association February 2, 1930.

cent. In forty cases (8 per cent.), the complaint was indefinite and in no way related to the gall-bladder; the finding of cholecystic disease was entirely incidental during the course of a thorough examination. Nausea and vomiting occurred in only 255 cases (51 per cent. of the series). Prompt relief was usually obtained by emptying the stomach, but in most instances the pain returned in a short time.

There are many minor complaints that may be valuable in the final summing up of all the clinical evidence entering into the diagnosis of disease of the gall-bladder, but there are only a few real essential high points as we have observed them. In the final analysis, we have a keen realization that ultimately the diagnosis of cholecystitis and the final disposition of the case must rest primarily in the hands of the clinician.

The surgeon is often perplexed to know whether or not a gall-bladder should be removed. The pathologist may sometimes find only slight evidence of disease in a gall-bladder that had been removed on the clinician's recommendation on account of symptoms sufficient to warrant such a procedure. The röntgenologist by cholecystographic means may detect a poorly

TABLE I

500 GALL-BLADDER OPERATIONS
Showing extent of operative procedure

Type of Operation	No. of Cases	Per Cent.
Cholecystectomy only	178	35.6
Cholecystectomy and Choledochotomy	29	5.8
Cholecystectomy and Appendectomy	245	49.0
Cholecystectomy and G. E. or Pyloroplasty and Appendectomy	48	9.6

functioning gall-bladder in a patient without complaint sufficient to justify cholecystectomy. He may also demonstrate good function in the presence of a complaint, and surgical and pathologic evidence sufficient to warrant the removal of the organ. In my experience, especially in the doubtful case, the acid test of whether or not a gall-bladder should be removed is the clinical history. Most of the surgeon's disappointments in the end result are related to cases in which there are cholecystographic evidence and surgical indications for operation but not a good clinical history.

Operative Procedure.—In the past, incomplete operation and often failure to remove intra-abdominal lesions have been causes of poor end results in many instances. In this series of cases it was necessary to do multiple operations in a large percentage of the cases, and therefore it may seem unfair to attribute all of the satisfactory end results to the removal of the gall-bladder. However, only those cases have been included in which the gall-bladder was considered the primary disease. The gall-bladder was removed only in 178 cases (35 per cent.). In most of them the appendix had been removed previously, or it was not considered sufficiently diseased to warrant its removal. The common bile duct was opened in thirty-three cases. The appendix was removed secondarily in 238 cases (47.6 per cent.).

When the appendix is present, and if it shows any degree of disease, it is our custom to remove it through the same incision. In forty-eight cases (9.6 per cent.), duodenal ulcer was found either before or during the operation. In each case gastro-enterostomy or some type of pyloroplasty was done besides cholecystectomy and appendectomy. Early in the series the combined operations were done with some hesitation but now with added experience and satisfactory end results, we feel perfectly safe and usually justified in doing the additional work. In practically all cases the entire operation has been completed within one hour. Here again the good end results may be influenced by the operations of the stomach and on the appendix. However, the gall-bladder was apparently the more severely diseased and clinically the chief offender. The main point to be emphasized is the complete eradication of all intra-abdominal disease.

From time to time over a period of many years, various surgeons have reported cases in which the gall-bladder had been removed and the abdomen

TABLE II

500 GALL-BLADDER OPERATIONS SHOWING THE RELATIVE PROPORTION OF CASES WHERE THE ABDOMEN WAS CLOSED WITH DRAINAGE AND WITHOUT DRAINAGE

Type of Operation	Abd. Drained	Abd. Not Drained	Per Cent.	Deaths	Per Cent.	Remarks
G. B. operation alone or combined with other upper abdominal operations	328		65.6	20	6.09	Chief cause of death pneumonia, myocardial and hepatic insufficiency
Cholecystectomy alone or combined with other upper abdominal operation		172	34.4	0	0	One patient died of suppurative parotitis 15 days P. O. Abdominal wound healed O. K.
Mortality for entire series of 500				20	4.0	

closed without drainage. Few, however, have reported a large series of cases. In our early work the abdomen was closed only in cases in which diabetes was present and it was desired to prevent infection of the abdominal wall and promote primary healing. The fear of leakage of bile into the peritoneal cavity had been the deterring factor in practically all cases. In a large group of cases in which infection is present, the tissues are soiled on account of the spilling of the bile and infected fluids during the removal of the gall-bladder, and often a certain amount of oozing of blood makes a dry operating field well nigh impossible. All agree that drainage should be carried out in such cases. About five years ago we began to close the abdomen without drainage in a selected group of clean cases, in which the field was dry and a minimal amount of trauma had occurred during cholecystectomy. As time went on, we extended the indications for such closure and now tight closure is made in more than 70 per cent. of cases. In this series, drainage was instituted in 329 cases (65.6 per cent.). The ducts were opened in thirty-three of them and bile came to the surface. A careful check of the

records of the hospital disclosed only ten cases in which bile was found on the dressing when simple cholecystectomy was performed and the ducts were not opened. In less than 3 per cent. bile drained. In two of the cases, after removal of the tubes, there was an accumulation of bile about the stump of the cystic duct several days after the wound had healed, which necessitated the reopening of both wounds and the evacuation of a large amount of infected fluid. Both patients recovered.

In 172 cases (34.4 per cent.) the abdomen was closed without drainage. It was not necessary to reopen the abdomen in a single case nor had there been evidence of leakage of bile into the peritoneal cavity. As a general rule the convalescence was easier, smoother and shorter when drainage was not used than when it was. If drainage was used the patients remained in the hospital an average of sixteen and five-tenths days; if it was not used, fourteen and six-tenths days. The wound was infected in forty-six (14 per cent.) of the former, whereas only eleven (6.4 per cent.) of the latter were infected.

Of the 328 patients whose wounds were drained, twenty (6.09 per cent.) died. They were generally poorer risks. The chief causes of death were

TABLE III

500 CHOLECYSTECTOMIES SHOWING NUMBER OF HOSPITAL DAYS AND CONDITION OF WOUNDS IN THE DRAINED AND UNDRAINED CASES

	Drained Group		Undrained Group	
	Cases	Per Cent.	Cases	Per Cent.
Cholecystectomy with or without opening ducts	328	65.6	172	34.4
Number of infected wounds	46	14.0	11	6.4
Number of cases drained bile P. O.	43	13.1	0	0
Average hospital days	16.5		14.6	

Ducts were opened in thirty-three of the drained group. Only ten cases drained bile after simple cholecystectomy.
No case in the undrained group showed evidence of bile leakage into the peritoneal cavity.

noted as pneumonia, and myocardial and hepatic insufficiency. One patient died on account of an embolism at the bifurcation of the abdominal aorta. Embolectomy was not done. The wound broke open in two other cases and both patients died following resuture of the wounds. There was no death which could be attributed to closure without drainage in the 172 cases of this group. One patient died on the fifteenth post-operative day. Double suppurative parotitis developed. Both parotid glands were opened and drained. A retropharyngeal abscess later formed and death was apparently due to meningitis. The mortality in the entire series of 500 cases was 4 per cent.

The problem of whether to drain or to close the abdomen tight after cholecystectomy is more or less contingent on accessory bile ducts and the peace of mind of the surgeon, except in the infected cases in which all agree as to the use of drainage. Moynihan stated that he closed the wounds in many cases without drainage when he was young and adventurous but now he drains in all cases after removal of the gall-bladder. At his request, Flint

studied 200 cases at necropsy to determine the incidence of accessory bile ducts and he found them present in 14.5 per cent. of the cases. I have seen accessory ducts in only two cases. Bile drained around the tube while the abdomen was being closed. In one instance, the abdomen was reopened, the cystic duct was found securely tied and the bile leaking from a small accessory duct. It ceased to flow in a day or two and the wound healed primarily. When the cystic duct and artery are clamped and tied together there seems to be less danger of leaving an open duct. This has been my custom.

Pathology.—The hospital records were carefully searched in all of the cases in this series. The pathologic report was tabulated in 486 of the cases. The cases have been graded into four main groups depending on the extent of the lesion. Grade I represents a mild degree of cholecystitis and grade IV represents the most severe condition, the gall-bladder being functionless, the walls thick and usually the cystic duct occluded. Grades II and III represent intermediate states, both showing rather marked evidence of disease. Only twenty-eight (5.8 per cent.) of the entire series were graded I.

TABLE IV

PATHOLOGICAL REPORT. GRADED I TO IV DEPENDING ON EXTENT OF LESION
(486 cases reported on by pathologist)

	Grade	No. Cases	Per Cent
Cholecystitis	I	28	5.8
Cholecystitis	II	229	47.0
Cholecystitis	III	176	36.6
Cholecystitis	IV	51	10.5
Cholecystitis with stones		192	40.0
Cholecystitis (Strawberry)		49	10.0
Cholecystitis (Acute)		22	4.5

Usually there was some question in the surgeon's mind about the indication for cholecystectomy in this group. When the clinical history was suggestive of cholecystitis, the surgeons would not hesitate to remove the organ. It may be noted that the "no relief" group in the follow-up study corresponds in the main to the group graded I. It is our observation and belief that the extent of the disease of the gall-bladder bears a definite relation to the end result after cholecystectomy. Formerly a large percentage of the gall-bladders removed had gone on to a stone-forming stage. Stones were present in 192 (40 per cent.) of this series. More stones were found in the cases graded III and IV than in those graded I and II. As time goes on and gall-bladders are removed earlier in the disease, it is probable that fewer stones will be found. The so-called strawberry gall-bladder was found in forty-nine cases (10 per cent.). Stones were present in several of them. It has been our observation that practically all diseased gall-bladders that produce symptoms are inflamed. The strawberry gall-bladder may be an exception. The lipoid infiltration of the mucosa may or may not be a disturbance of cholesterol metabolism that alters the function of the organ.

Many years ago Virchow called attention to such a possibility. We have observed that some of our worst cases clinically, even accompanied by severe attacks of colic, have been of this variety. Apparently there is a great tendency to myocardial involvement during the course of this disease. The relief has been most striking after the removal of the strawberry type of gall-bladder.

A carefully prepared questionnaire was mailed to each patient. They were asked to state: (1) whether or not they had obtained relief from the symptoms for which the operation was performed; (2) whether there had been improvement of the digestive disturbance; (3) what the condition of the wound was relative to a bulge or hernia; (4) recurrence of colic, if any, and (5) if they had been jaundiced since the operation.

Twenty patients died in the hospital and eighteen died later from other causes. Thirty questionnaires were returned unclaimed and eighty patients could not be traced. Two hundred seventy-six responded to the questionnaire and seventy-six others were either recently reëxamined at the clinic

TABLE V. FOLLOW-UP STUDY OF 500 CHOLECYSTECTOMIES FROM 1921 to 1928, INCLUSIVE

20	died in hospital
30	questionnaires returned unclaimed
18	died later from other causes
80	could not be traced
276	responded to the questionnaire
76	were either reëxamined or condition known by personal observation
352	known cases form the basis of this study

or their conditions were known by personal observation. The follow-up study is therefore based on 352 traced cases.

The benefits obtained as related to questions 1 and 2 were classified into complete, partial and the no relief groups. I was surprised to find that 269 (84 per cent.) of the patients were completely relieved of the symptoms for which the operations were performed. As has been mentioned, other diseased organs besides the gall-bladder were removed in many instances. This may have favorably influenced the end results in many cases. Forty-two patients (11.6 per cent.) reported only partial relief but were improved. Only fourteen (4 per cent.) were not benefited.

It was gratifying to note that the digestion was greatly improved in 306 cases (87 per cent.). Only partial relief was obtained in thirty-three cases (9.3 per cent.). Thirteen of the entire group (3.7 per cent.) were not relieved or were made worse.

The condition of the wound was satisfactory in 91.5 per cent. of the cases whereas a bulge or hernia occurred in thirty (8.5 per cent.) of the entire group. The incidence of post-operative hernia was far greater in cases in which the wounds were drained than in cases in which they were not drained. Strangely enough, practically all the hernias that occurred were

in the cases in which operation had been done through an upper right rectus incision with the rectus muscle retracted to the outer side. Hernias through such wounds are far more difficult to repair than if the rectus fibres have been separated in the usual muscle-splitting type of operation.

Eighty-seven and two-tenths per cent. of the patients did not have colic after the operation whereas 12.5 per cent. reported having had one or more spells of "bilious" colic. The pain was similar to the former spells and in practically all cases the patients were afraid of the return of the original trouble. After the colic had subsided there was no jaundice in most cases and the progress was then as smooth as it was in the uncomplicated cases. In two cases stones were later found in the common bile duct and a secondary operation was necessary. In the remaining number it was not possible to determine the cause of recurrent pain in the absence of any apparent unremoved lesion.

TABLE VI

FOLLOW-UP STUDY OF 500 CHOLECYSTECTOMIES SHOWING SUBSEQUENT STATE OF HEALTH

(352 cases heard from and form the basis of this study)

	No. Cases	Per Cent.
Complete relief of symptoms for which operation was done	296	84.0
Partial relief of symptoms	42	11.6
No benefit or made worse	14	4.0
Digestion much improved	306	87.0
Only partial relief	33	9.3
Digestion not benefited or made worse	13	3.7
No colic	307	87.2
Recurrent colic	45	12.5
No subsequent jaundice	336	95.4
One or more attacks of jaundice	16	4.5
Condition of wound O. K.	322	91.4
Bulge or hernia	30	8.5

Sixteen patients (4.5 per cent.) reported the appearance of post-operative jaundice of some degree. This could be accounted for in two cases by the finding of stones in the common bile duct but in the others the cause was less certain. The icterus soon disappeared and did not leave any bad after effect.

A review of published reports of the last several years was made to ascertain how nearly our observations correspond with those of others.

Thirteen series of cholecystectomies (those of Cave,[1] Clark,[2] Danzis,[3] Davis,[4] Fallon,[5] Hitzrot and Cornell,[6] Hueck,[7] Iselin,[8] Johnson and Pearre,[9] Judd and Parker,[10] Lahey,[11] Marks,[12] Verbrycke[13]) in which the operative mortality is noted present an aggregate of 4032 cases, a mortality of 191 (4.73 per cent.). Iselin reports a series of 100 cholecystectomies, including eight in which drainage of the common bile duct was also done, without a death; Marks, a series of seventy-five without a death.

Cause of Death.—Peritonitis, pneumonia, bronchopneumonia and shock

were the chief causes of the thirty-seven deaths in the hospital in Hitzrot and Cornell's [6] 400 cases. Cardiac failure accounted for five of the twelve deaths in Johnson and Pearre's [9] 192 cholecystectomies. Cardiac disease, peritonitis, hæmorrhage, pulmonary embolism and bronchopneumonia were responsible for two deaths each, in the twelve deaths among 845 simple cholecystectomies reported by Judd and Parker.[10] Cave [1] reports pneumonia, hæmorrhage, peritonitis, pulmonary embolism and immediate hyperpyrexia as the main causes of the thirty-two deaths in his series of 470 cholecystectomies. The hyperpyrexia, he believes, was due to absorption of diseased or chemically altered liver cells or toxic bile.

In thirteen series (Cave,[1] Clark,[2] Dahl-Iversen,[14] Danzis,[3] Davis,[4] Fowler,[15] Lahey,[11] Hitzrot and Cornell,[6] Hueck,[7] Johnson and Pearre,[9] Marks,[12] Seulberger,[16] White and Riddick [17]) showing late results, 2,222 traced cases are represented. One thousand six hundred ninety-nine patients, or 76.4 per cent. are reported as well; 321 (14.5 per cent.) as improved, and 145 (6.5 per cent.) are unimproved. When we attempt to compute mathematically with such conceptions as "well," "improved," and "unimproved," determined on a basis of symptoms, we enter a region of quicksands, and, arrived on the other side, we feel entirely uncertain as to how much of the truth we have succeeded in carrying over. The figures of the individual series vary so widely that one suspects that differences in wording the questionnaires and in evaluating the answers are partly responsible for the differences. It may be noted, however, that in seven of the reports the percentage of patients well after the operation is in the eighties; in one, in the nineties.

Several of the authors think that errors of diagnosis should bear the blame for the greater part of their failures. White and Riddick [17] believe that too much stress was laid on the X-ray findings. Judd [18] notes that the diagnosis was not definite in most of the failures among his cases of mild cholecystitis.

Pathology of Gall-bladders Removed.—Davis'[4] series was about equally divided between cholecystitis with and without stones. The group with stones gave better end results. Hadley's [19] and Hitzrot and Cornell's [6] series show the same advantage on the side of calculous cholecystitis. Hueck's [7] series shows a trifling advantage on the side of cholecystitis without stones. Judd [18] saw the best late results in strawberry gall-bladders with stones (96 per cent. good results), nearly as good (93 per cent.) in severe cholecystitis (grades II, III and IV) with stones. In the same conditions without stones, operation gave good results in 87 and 88 per cent., respectively, while in mild cholecystitis (grade I) the percentage of good results was 84.4. In Seuberger's [16] series only 82 per cent. of the gall-bladders in the group of patients not freed from symptoms had presented actual disease at operation, whereas the group freed from symptoms by the operation had shown severe changes in the gall-bladder in 96.3 per cent. In the former group the patients were younger and the duration of the disease before operation was shorter than in the latter group. Eighty-eight per cent. of the gall-bladders

TABLE VII

SUMMARY OF CASES REPORTED BY THE FOLLOWING AUTHORS DURING THE PAST EIGHT YEARS SHOWING THE END RESULTS AFTER CHOLECYSTECTOMY

Author	Cases	Traced	Per Cent.	Well	Per Cent.	Improved	Per Cent.	Not Improved	Per Cent.	Deaths	Per Cent.	Not Drained
Cave	470	209	44	182	86.1	21	10.0	6	2.8	32	15.3	22
Clark	108	102	94	82	80.2	17	16.6	3	2.2	5	4.6	—
Dahl-Iversen	146	146	100	126	86.3	11	7.0	19	12.0	—	—	—
Danzis	113	113	100	90	80.0	8	7.1	8	7.1	5	4.3	—
Davis	156	144	92	100	69.4	38	26.4	6	4.2	4	2.7	—
De Courcy (Lahey)	64	64	100	51	80.0	6	9.3	3	4.5	4	6.2	—
Fallon	800	800	100	—	—	—	—	—	—	37	4.6	—
Fowler	422	422	100	396	93.8	13	3.0	12	2.8	—	—	—
Hitzrot and Cornell	400	384	96	203	52.8	107	28.0	30	7.5	37	9.6	—
Hueck	263	135	51	89	65.8	26	19.3	20	14.9	19	14.0	—
Iselin	100	100	100	—	—	—	—	—	—	—	—	—
Johnson and Pearre	192	120	62	72	60.0	45	37.5	3	2.5	12	6.25	—
Judd and Parker	989	989	100	—	—	—	—	—	—	15	1.5	—
Marks	75	56	75	38	67.85	14	25.6	4	7.0	—	—	13
Seulberger	304	217	72	180	82.09	6	2.0	20	9.0	—	—	—
Verbrycke	302	302	100	—	—	—	—	—	—	21	6.9	—
White and Riddick	200	110	55	90	82.0	9	8.0	11	10.0	—	—	—
Sanders	500	352	70	296	84.0	42	11.0	14	4.0	20	4.0	172

in Marks'[12] series were grossly pathologic; nine (14.5 per cent.) were grossly normal, but the histories were typical for gall-bladder disease. Microscopic examination showed mild chronic inflammation in seven of these. Seven of the nine patients concerned were heard from; four were symptom-free, two were improved, one was unimproved. Palpable stones were present in 65 per cent. of the entire series. Chronic cholecystitis with stones was found in just over half the cases; the same without stones in 21 per cent.; stones without changes in the gall-bladder in 23 per cent. Wideröe[20] found stones at 90 per cent. of his interval operations, at 65 per cent. of his operations performed during the attack.

Digestion.—Indigestion for certain foods occurred in 19.8 per cent. of Marks'[12] cholecystectomized patients; in 8.9 per cent. the intolerance was to fat. Mild irregularity in digestion was noted in 10.7 per cent.

Agrifoglio[21] made a series of experiments on dogs and demonstrated decreased utilization of fats—chiefly soaps and fatty acids—after loss of the gall-bladder. This decrease did not set in at once, but within ninety days. After from ten to fifteen months the utilization of fats, except soaps, improved.

The question of gastric acidity comes into the problem of digestion after cholecystectomy. Popper[22] and Seulberger[16] have made observations on this point. Popper tested the gastric juice of more than one hundred persons, some earlier and some later than one and a half years after removal of the gall-bladder. He found that the operation did not have the effect of decreasing acidity except in cases with severe inflammatory complications. Seulberger's studies, made on groups of patients before and after cholecystectomy, indicate, likewise, that deprivation of the gall-bladder does not lower gastric acidity. In the group of patients not definitely freed from symptoms, the percentage with subacidity and anacidity was much higher both before and after operation than in the patients whose symptoms became entirely relieved, but the operation did not raise the percentage in either group. Seulberger's acidity studies were carried out on only about one-third of the total number of patients in each group. Analysis of the groups in their entirety showed that 27 per cent. of this group not freed from symptoms had poor digestion for heavy foods, whereas among the 180 patients whom the operation had freed from the symptoms for which it was undertaken only one had any digestive trouble—difficulty in digesting fats. Johnson and Pearre[9] found that indigestion, gas and constipation were the symptoms most often unrelieved.

Colic and Jaundice.—The question of the return of colic was studied by Hueck.[7] In 14.9 per cent. of his series of 135 patients colics persisted at the time of the reëxamination, from two to twelve years after operation. A further 6.6 per cent. had had colics since the operation, but had them no longer. His analysis showed recurrence of colic to be independent of the type of lesion, of the age of the patient, and of the time of operation, whether early or late. The colics may be localized in the biliary tract or in the stomach or intestine and he believes they are phenomena of nerve

disturbance. Judd [18] found colic and jaundice in 75 per cent. of his poor results in cases of chronic strawberry gall-bladder without stones, in 33 per cent. of his poor results in cases of severe cholecystitis without stones, and in 100 per cent. (two cases each) of the same conditions with stones. Marks [12] reports three cases of jaundice in sixty-seven replies.

Question of Post-operative Drainage.—While the question: to drain or not to drain, has been the subject of heated argumentation, particularly in the European medical press, I have seen only three series of considerable size comprised wholly of undrained cases. Verbrycke [23] reports eighty-six consecutive cases of closure of the abdomen without drainage after cholecystectomy. There were no deaths. He analyzes thirty of these cases as to late results: No symptoms after operation, twenty-one cases; improvement, five; death (carcinoma of the pancreas), one; untraced, three. Fowler [15] published a series of eighty-one cases in which closure without drainage was practiced. There were two post-operative deaths. He compares the results in sixteen of these cases, on which he had a report one year or more after operation, with a series of 406 cases with post-operative drainage, reported on after a similar interval. In the non-drained group the results were: complete relief, 70 per cent.; fair result, 19 per cent.; no relief, 11 per cent. In the drained groups: complete relief, 94.8 per cent.; fair result, 2.48 per cent.; no relief, 2.7 per cent. Richter [24] has been closing the abdomen without drainage more than twelve years and is more and more enthusiastic about it with added experience. He has been widening the indication for such practice as experience has justified it. In his last series of 100 cases, eighty-three were closed tight. He reports having closed 204 cases without a death that could be attributed to the method. He does not think bile leakage occurred in any of them. He has been bold enough to close the abdomen tight after opening the common duct. He infers that the end result is better and the mortality less in all cases where the method is suitable. Davis [4] does not give his figures, but states that he believes that in the average case the wound may safely be closed tight and that the end results are better when this is done.

Comment.—The results of this study have been very gratifying. It has shown better end results than were anticipated. Valuable lessons have been learned about the proper selection of cases for surgical treatment. The clinical data ascertained and properly interpreted by the clinician constitute the most important factor entering into advice given the patient as to the treatment leading toward a satisfactory future state of health. Cholecystography is a most valuable aid in diagnosis. In the border-line cases of mild chronic cholecystitis, the surgeon is greatly aided in his decision to remove the gall-bladder by the recommendation of the clinician and röntgenologist.

In properly selected cases the abdomen can safely be closed without drainage after cholecystectomy.

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INFLAMMATION OF MECKEL'S DIVERTICULUM

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Acute inflammation of Meckel's diverticulum has especially interested the writers, since in a comparatively short time, July, 1927, to April, 1929, they have operated upon six cases. Four of these were reported in a previous paper.[1] The relative frequency with which we have observed this bizarre abdominal condition has so impressed certain diagnostic features upon us that we were able, in two of our last three cases, to anticipate, pre-operatively, the findings of an involved Meckel's diverticulum.

Case V.—A well-nourished female child, aged two and one-half years, was admitted to the United Israel-Zion Hospital October 27, 1928. The day before admission the child had developed abdominal cramps. An enema was given with some apparent relief. During the afternoon of the same day, the child vomited frequently. After taking some orange-juice, the abdominal pain became more marked. On the morning before the child's admission a bicarbonate of soda enema was given and a bloody return noticed. Abdominal pain was still present and very colicky. No fluids could be retained. The child appeared drowsy except when aroused by attacks of pain. Several spontaneous bloody discharges from the rectum appeared, especially after the attacks of colic.

Physical Examination.—On palpation of the abdomen, there was noted a sense of resistance in the upper right quadrant, but no mass could be definitely felt. The rectal examination was negative, but when the examining finger was withdrawn, there followed a gush of dirty, reddish-brown, bloody mucoid fluid. A barium enema given during a fluoroscopic examination showed that the clysma column had only passed to the hepatic flexure of the colon. Temperature was 100°F., pulse 100 and respiration 20. The total white blood cell count was 7,400, with normal polymorphonucleosis. The pre-operative diagnosis was intussusception.

Operation.—Through a right rectus incision, there was found a telescoping mass, at the hepatic flexure of the colon, which, when gently reduced, proved to be the cæcum telescoped into the ascending colon, ileum telescoped into the cæcum and part of the ileum telescoped within itself. About fifteen inches from the cæcum there was a free Meckel's diverticulum about one inch long, funnel-shaped, with a broad base, very hard at the distal end, and without a mesentery. Since the diverticulum was not acutely inflamed, it was considered a safer procedure to do a diverticulectomy at a later stage. This was done on December 27, 1928, when the child was readmitted to the hospital. At this time a subumbilical incision was made. The diverticulum was found as described. Diverticulectomy was performed by crushing the base of the structure with a clamp and removal by cautery, inversion of the stump and peritonealization. The recovery was uneventful. The examination by the pathologist confirmed the diagnosis of Meckel's diverticulum with intestinal mucosa.

Case VI.—A well-nourished boy, aged thirteen years, was admitted to the United Israel-Zion Hospital April 10, 1929. He had severe abdominal cramps the day before admission. The pain was localized at the umbilical region and was cramp-like in character. He had vomited about ten times since the onset of his illness; the temperature was 103°F., pulse 128 and respiration 28. The boy appeared extremely ill, with intensely flushed cheeks simulating pneumonia. The general toxic aspect was far more severe than that seen in the usual attack of acute appendicitis with associated peri-

tonitis. The thighs were drawn up. There was considerable abdominal distention. Tenderness and rigidity were most marked below the umbilicus and slightly to the right. Total number of white blood cells was 19,400, with polymorphonuclear leucocytes 86 per cent, and lymphocytes 14 per cent. The pre-operative diagnosis was acute inflammation of a Meckel's diverticulum.

Operation.—Right rectus incision. Upon entering the peritoneal cavity, there was an escape of a considerable amount of thin, free, cloudy, blood-tinged reactionary fluid. This was removed by suction. A Meckel's diverticulum was located adherent to the peritoneal surface of the umbilicus by a thin, tight, cord-like, ensnaring band, producing

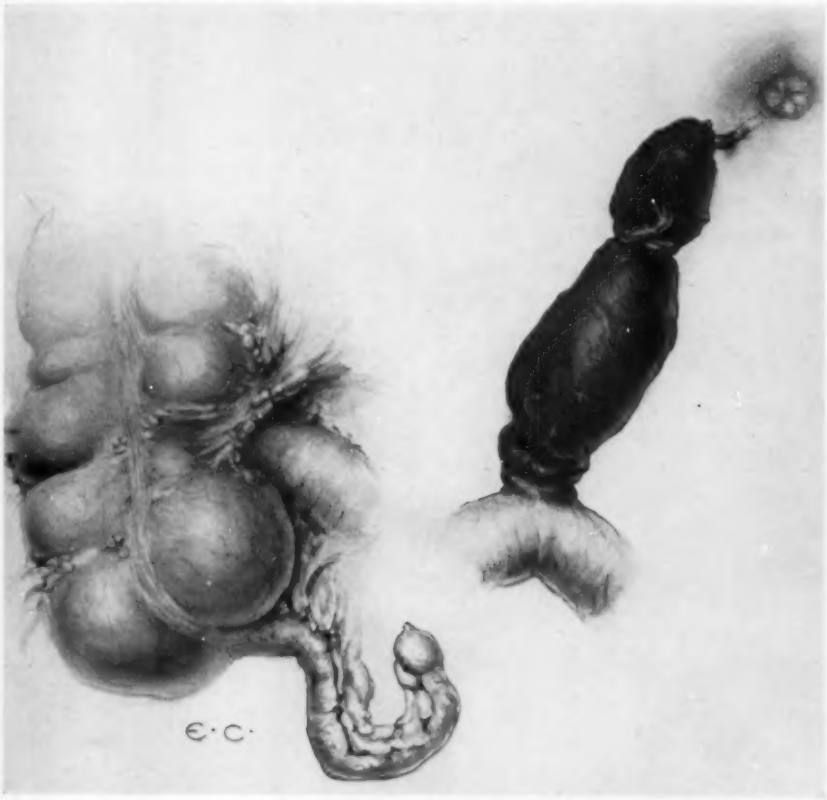

FIG. 1.—Blood-filled Meckel's Diverticulum with torsion.

a torsion of the diverticulum. (Fig. 1.) It was found to be about sixteen inches from the ileocæcal junction, about five inches in length, purplish-black, and filled with blood. It had no mesentery. The lumen was approximately that of the parent ileum. The terminal end was blind, blunt and sausage-like, and the base sprang from the ileum opposite its mesenteric attachment. Diverticulectomy was performed with stump inversion and peritonealization. The appendix was removed. Recovery was uneventful.

Pathological Report.—Acute phlegmonous inflammation of Meckel's diverticulum.

Usually Meckel's diverticulum is an anomalous glove-finger-like sacculation or out-pouching of the ileum, and may be situated anywhere from several inches to three feet above the ileocæcal valve.[2] Almost any variation of size, shape and position may be possible.

This surgical condition was first observed by Lavater in 1671, and then by Ruysch in 1698. It was not until 1813, however, that John Friedrich Meckel first accurately and completely described this structure which carries his name.

Meckel's diverticulum, in contradistinction to all other forms of intestinal diverticula, is almost always a congenital entity. "In the beginning of fetal life the midgut is connected to the yolk sac by a wide canal called the vitelline duct. This duct is accompanied by an artery and two veins which maintain the circulation between the yolk sac and the intestines. At about the eighth week the duct becomes functionless, and, under normal conditions, disappears; the atrophy beginning at the distal end. In about two per cent., atrophy is not complete and varying portions of the duct remain, and it is this remnant of fetal life which is known as Meckel's diverticulum." [3]

The duct may remain patulous throughout its entirety, and thus form a fistulous communication from the small intestine to the umbilicus, discharging mucus and intestinal contents. More frequently the distal end of the duct may become obliterated, leaving only a fibrous cord which may become attached to the umbilicus, to the anterior abdominal wall or to any other structure in the abdomen. This cord or tip of the diverticulum may become attached to, and part of, an inguinal hernia (Littre), or to any portion of the mesentery (its most frequent attachment), or to a neighboring loop of gut (small or large), bladder, or appendix.

Meckel's diverticula vary greatly in size, from a slight nipple-like structure to one thirty-three and one-half inches long.[4] The duct is usually free of mesentery, although in two of our cases we found a distinct mesentery. The structure of its walls is similar to the ileum from which it springs, and its mucosal lining may contain Lieberkühn's glands and Peyer's patches. However, there are reported instances where the distal mucosa of the diverticulum revealed the gastric type of glands, whereas the proximal mucosa contained alkaline secreting glands. At the junction of these two types of glandular mucosa, ulcers may form.[5] These ulcers are homologous to gastrojejunal ulcers subsequent to gastrojejunostomy. The origin of this gastric type of mucosa has not been satisfactorily explained. The lumen of the diverticulum is in most instances the same size as the parent ileum, but at times the communication between the duct and gut is very narrow, with a valve-like action, or it may be entirely closed. In the latter case, the secreting glands of the mucous lining may give rise to the formation of cysts.[6]

Meckel's diverticulum is usually attached to the ileum opposite to the mesentery, but it may be at right angles to the latter or within the folds of the mesentery. In shape, the structure may be tubular, club-shaped, nipple-like, round or irregular.

Incidence.—All writers seem to agree that Meckel's diverticulum is present in from one to two per cent. in all human beings, but the actual figures of various investigators show a smaller percentage. It is present in males three

times as often as in females.[7] In our series there were five males and one female, and the average age was twelve years.

Christopher [8] summarizes Doefner's and Telling's statistics as follows:

DOEFNER'S FIGURES

Zurich	11,822 autopsies,	14 Meckel's diverticula
French & English	4,848 autopsies,	90 Meckel's diverticula
Total	6,670 autopsies,	104 Meckel's diverticula
1.5 per cent.		

TELLING'S FIGURES

Dresden City	8,133 autopsies,	8 Meckel's diverticula
Boston City	1,382 autopsies,	11 Meckel's diverticula
Johns Hopkins	2,600 autopsies,	15 Meckel's diverticula
Bender Hygienic	953 autopsies,	5 Meckel's diverticula
Total	13,068 autopsies,	39 Meckel's diverticula .3 per cent.

Balfour in a total of 19,600 consecutive laparotomies noted only fifteen Meckel's diverticula, a percentage of .14.[9]

McGlannan [10] found only three cases in more than 14,000 abdominal operations, and he adds that Coley and Fortune reported only fifteen Meckel's diverticula in 18,000 autopsies.

The surgical phenomena that may arise from the presence of a Meckel's diverticula are: 1. Intestinal obstruction. 2. Ulceration (with or without bleeding from rectum). 3. Intussusception. 4. Diverticulitis (acute or chronic).

Intestinal obstruction is by far the most frequent surgical complication of a Meckel's diverticulum. This may occur in a variety of ways; Halstead classifies them as follows:

A. *Free unattached diverticulum.*—(1) Knot tied around gut. (2) Dragging and kinking of a loop of intestine by a distended or cystic diverticulum. (3) Twisting of the bowel at the point of origin of the diverticulum. (4) Chronic inflammation of Meckel's diverticulum and intestine with cicatricial narrowing. (5) Acute diverticulitis.

B. *Diverticulum attached to the abdominal wall or an abdominal viscus.*—(1) Band constricting or interfering with the blood supply. (2) Volvulus produced by a loop of gut passing between the diverticulum and becoming twisted. (3) Volvulus of a loop of intestine attached to the diverticulum with the diverticulum as a fixed point of rotation. (4) Strangulation over a tightly drawn diverticulum. (5) Acute diverticulitis. (6) Prolapse of intestine through umbilical fistula.

Ulceration is the most frequent complication of Meckel's diverticulum. The ulceration is analogous to that occurring in the stomach, and may be referred to as a peptic ulcer of a Meckel's diverticulum. Often the clinical picture is that of a pale child with a story of repeated intestinal hæmorrhages of bright red blood unmixed with mucus. These hæmorrhages may be so

profuse as to cause a marked anæmia.[11] Vomiting and epigastric pain may be present.

Hæmorrhages may be followed by perforation; the condition is then much more serious than perforation from a gastric ulcer, because the contents of the ileum are more infective. In a series of thirteen collected cases (all in boys), two of which were operated by them, Stulz and Woringer[12] reported ten perforations with seven deaths.

Intussusception is not infrequently caused by a Meckel's diverticulum invaginating itself into the ileum.[13] Here the severe pain, colic and vomiting are much more the prominent symptoms, whereas they may be absent in a bleeding diverticulum. The bleeding in an intussusception is usually not profuse and contains mucus.

Acute Diverticulitis (Meckel's).—Under this heading may be classified five of our six cases. While there is no distinct symptom or syndrome sharply differentiating this condition, there are certain peculiar characteristics that are helpful to make possible a pre-operative diagnosis of an acute inflammation of a Meckel's diverticulum.

The onset of this condition is usually abrupt. The pain is colicky and severe, appearing early and recurring. A very important feature is that the pain, tenderness and rigidity at the onset are usually localized near the umbilicus, about one-half inch below, either to the right or left. *Clinically the course simulates an acute inflammatory or perforative lesion of a hollow abdominal viscus, plus an early and partial intestinal obstruction.* If allowed to proceed without interference, a generalized peritonitis, perforation or obstruction may obscure the diagnosis completely. Vomiting is a constant and persistent symptom and tends to recur many times during the progress of the inflammatory process, due to the frequent attachment of the appendage to nearby organs; the ensnaring and kinking of intestines causes the frequent obstructive phenomena. Distention is a prominent sign and is evident rather promptly, in marked distinction to an early case of appendicitis. This distention is usually most distinct below the umbilicus. The temperature is often high, frequently 103° F. The patient appears acutely ill and the toxic reactions are more marked than in appendicitis.

Treatment.—No case of Meckel's diverticulitis can be considered innocuous; the likelihood of frequent and serious complications are many. Diverticulectomy with stump inversion and peritonealization is required. Care must be taken that the lumen of the gut is not narrowed. If perforation and a diffusing peritonitis have occurred, due to delayed operation, the treatment then is directed to both conditions. If ileus has resulted, drainage of the ileum above the lesion by an enterostomy is indicated. In none of our cases was this measure necessary.

SUMMARY

Six cases (the last two reported here), five males with acute inflammation of Meckel's diverticulum, and one female with a Meckel's diverticulum

not acutely inflamed, were operated upon within a period of two years—all recovered.

Pre-operative diagnosis, in two of our last three cases, was based on the persistent and repeated colicky pains, the localization of the maximum point of tenderness near the umbilicus, the recurrent vomiting, the severe toxicity, distention and high temperature.

In all acute surgical abdominal conditions, when the findings at operation are not sufficient to account for the symptoms, a search should be made for a Meckel's diverticulum.

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THE SURGICAL TREATMENT OF URINARY INCONTINENCE IN WOMEN*

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Impairment of bladder control is a frequent cause of complaint among women seeking relief from the disabilities consequent on childbearing. I have looked over the follow-up records filed under cystocele and prolapse at St. Luke's Hospital in an effort to determine the frequency with which incontinence was present as well as the result of treatment. These cards record only the chief complaints of the history so that information gleaned from them gives merely the proportion in whom vesical weakness was important in the patient's mind.

Seven of fifty-nine cases of cystocele and four of 175 cases of prolapse complained of some degree of incontinence. Combined, the incidence of deficient vesical control is 5 per cent. Of the eleven cases with incontinence there were follow-up reports in ten. All but two of these were described as having a good result or being improved. These figures indicate that in general the operations done restored the bladder control. Taylor and Watt[1] found the incidence of loss of control in a series of hospital cases to be 2 per cent.

There are, however, a few patients in whom incontinence is complete or almost so, presumably associated with injury to the sphincter, who present a difficult problem to the surgeon. The following report describes such a case.

Mrs. E. D., a matron, forty years of age, was admitted to St. Luke's Hospital February 22, 1928, complaining of falling of the womb and inability to hold urine. Since her first confinement twenty-two years before she had had some degree of prolapse. Subsequent to the birth of the fifth and last child six years before she had not been able to prevent leakage of urine while on her feet. When sitting or lying down she remained dry.

On examination she was a healthy appearing, rather obese woman. There was a marked cystocele and moderate rectocele. The cervix was hypertrophied. The fundus remained anterior and apparently well supported.

Trachelorrhaphy, anterior colporrhaphy and perineorrhaphy were done for her relief. The anterior colporrhaphy was of the side-to-side overlap type. Convalescence was uneventful.

Three months later she was readmitted to the hospital because of continued incontinence, worse than before the operation. She could not walk without drenching herself. Examination revealed what appeared to be an excellent anatomical result from the previous plastic operation. Pressure on the abdomen or anterior vaginal wall, however, caused a flow of urine to come from the urethra. A cystoscopic examination was negative except for relaxed sphincter. A Kelly operation was done. With a catheter in

* Read before the New York Surgical Society April 23, 1930.

the bladder as a guide an incision was made in the anterior vaginal wall down to the base of the bladder. The vesical neck was plicated and the urethra narrowed by buried sutures, redundant vaginal mucosa was excised and the incision closed. The urethra at the close of the operation grasped a metal catheter tightly.

Following this operation the patient could not void and was unfortunately allowed to accumulate forty ounces in the bladder before being catheterized. It was necessary to depend on catheterization for four days. On discharge on the ninth day it was noted that the patient was continent.

For about two weeks following discharge she was well, but thereafter the incontinence returned and became worse than ever before. She was unable to go among friends because of the continued wetness and urinous odor and had to give up a job at a summer camp. Even in bed she did not remain dry and wore a pad. At a second cystoscopic examination six months after the second operation the sphincter was described as congested and relaxed with the edge running directly even with the bladder wall. The trigone and remainder of the bladder were normal. A diagnosis of relaxed sphincter was again made.

The patient's deplorable condition, worse since her previous operations, demanded relief, yet to the perplexed surgeon the current textbooks had little to offer other than the Kelly procedure, while the complicated muscle plastics reported from time to time seemed hardly indicated before simpler procedures were given a further trial. In view of the experience of the last operation at which time the sutures were undoubtedly put to undue strain, and under the stimulus of an article on female epispadias by Davis [2] in which he emphasized the importance of suprapubic drainage with sphincter repair, it was determined to employ this principle.

The patient entered hospital for her third operation in January, 1929, eleven months after the first and seven after the second intervention.

A suprapubic cystotomy was done first. The patient was then put in the lithotomy position and with the finger of an assistant in the urethral orifice of the bladder as a guide the base of the bladder was exposed through an incision in the anterior vaginal wall. The mucous membrane of the bladder was accidentally torn through in making the dissection but it was repaired at once and no harm resulted. Although it was not possible to identify sphincter muscle as such the musculature at the neck of the bladder was recognized and tightened by sutures. In order to include every step that might help in the cure an interposition was added. The bladder was drained suprapubicly.

Convalescence was uneventful. The patient was allowed out of bed on the fourteenth day with the tube clamped. She voided on the fifteenth day. On the seventeenth day the tube was removed. On discharge from the hospital on the thirty-third day the wound was completely closed and the patient continent.

She has remained cured to date, more than one year, and has been able to resume all her activities. She can cough or laugh without losing a drop of urine. She voids three or four times by day and gets up once at night. On examination the bladder is well held up by the interposition.

Anatomy.—Descriptions of the vesical sphincter vary sufficiently to confuse the reader as to details. In general it may be said that there is an internal sphincter of smooth muscle, and an external, consisting of the voluntary muscles surrounding the urethra, the compressor urethra and bulbocavernosus, which supplement the action of the more important internal sphincter.

According to McCrea [3] the internal sphincter consists of two parts which together form an encircling band at the vesical neck, an inner, continuous with the muscle fibres of the trigone, the sphincter trigonalis of Kalischer; and an outer, derived from the posterior band of the external longitudinal

muscular coat of the bladder. The circular muscular fibres of the bladder which have been considered by some writers as the origin of the sphincter musculature form an incomplete ring just above the sphincter, deficient posteriorly. The internal sphincter is therefore intimately connected with the trigone and base of the bladder and represents a combination of their fibres looping around the vesical neck and upper end of the urethra. The result of this arrangement is that at operation the vesical sphincter is not to be separately identified as in the case of the anal sphincter, at least in my experience and I would judge that of others, and sutures designed to repair it must include in general the musculature of the bladder neck and adjacent portion of the urethra.

Pathology.—Relaxation of the sphincter is a term often used in discussing the incontinence of women who have born children and expresses undoubtedly a common conception of the underlying condition. The fact, however, that some degree of incontinence is not rare in women with cystocele and that it is usually cured by operative repair of the cystocele demonstrates that an injury of the fibro-muscular supports of the bladder and urethra is an important cause of impaired vesical control. Taylor and Watt,[1] Watson,[4] Bonney,[5] Miller,[6] and Latzko and Schiffman[7] emphasize this as the principal feature. Miller[6] believes that where prolapse is incomplete, the base of the bladder descending while the urethra is held up, incontinence is more likely than in complete prolapse, because in the former the sphincter is held open. The greater incidence of incontinence among the St. Luke's cases of cystocele as compared with those of more extensive prolapse would seem to support this view.

Stoeckel,[8] who has had a large experience in the treatment of incontinence, emphasizes the importance of lacerations of the internal sphincter itself and restricting adhesions to it.

A third theoretical cause would be injury of the innervation of the sphincters. As that of the internal sphincter is through the pelvic plexuses which follow the arterial branches it would seem unlikely to be of importance and in fact I have found no evidence in looking over the literature that it is so. A possible injury of the internal pudics which supply the muscles forming the so-called external sphincter seems of even less practical import.

It may be concluded that impairment of the bladder and urethral supports is the common cause of incontinence in parous women but that on the other hand injury to the internal sphincter itself must be present in the more severe cases.

In the patient described above the condition grew worse after an anterior colporrhaphy and perineorrhaphy the result of which was considered anatomically good, so that sphincter injury remained as the explanation. This was furthermore borne out by cystoscopic examinations which showed the sphincter to be relaxed.

Treatment.—Where a careful repair of the anterior vaginal wall and other prolapse is insufficient to cure the incontinence, the Kelly operation, a

reefing of the tissues at the bladder neck, thereby restoring the sphincter mechanically, is the operation generally practised. Kelly and Dumm,[9] reported sixteen of twenty cases cured by this procedure. Furness,[10, 11] reports 80 per cent. of successes. In some instances where a vaginal operation was not feasible he has tightened the sphincter through a suprapubic approach. E. L. Young, Jr.,[12] has reported a series of eighteen cases with no known failures. He emphasizes the plication of the vesical sphincter, and second, a careful repair of the fibro-muscular tissues forming the external sphincter.

Other operations frequently mentioned are the Gersuney, which depends on a twisting of the urethra, the Dudley, a forward displacement of the urethra which tightens and angulates it, and paraffin injections whose purpose is to narrow the calibre of the urethra. These are all based on wrong principles in my opinion and are mainly of historical interest.

The Germans, judging from their literature, have taken the most interest of recent years in the problem under consideration. Stoeckel,[8] considers the direct plastic on the sphincter muscle as the basic method of attack. For such cases as are not cured by this procedure he describes three operations, pyramidalis plastic with which his name is associated, levator plastic and interposition.

The pyramidalis plastic introduced by Goebel and first used by Stoeckel in a case of acquired incontinence consists in bringing two muscular strips, theoretically consisting of the pyramidalis muscles, but which may for practical purposes include rectus or fascia, down back of the symphysis and suturing them together underneath the vesical neck. Their bases are left attached above. According to Latzko and Schiffmann,[7] more than 100 of these operations have been reported with very good results. The levator plastic of Franz consists in suturing strips from the upper part of the levators to each other underneath the vesical neck. Their bases are left attached to the pubic bone. Both the pyramidalis and levator plastic depend on supporting rather than sphincter action.

Other muscle plastics using the musculature of the thigh or even the gluteus have been recorded according to Latzko and Schiffmann. Mention should be made of the gracilis plastic devised and carried out by Deming,[13] of New Haven, who achieved a brilliant success in a young woman with epispadias, incontinent since birth.

Finally it has been observed that the interposition operation has been helpful in cases of incontinence, supporting as it does the base of the bladder.

Discussion.—To return to the direct plastic on the vesical sphincter region, as already mentioned, the percentage of successes by this simple procedure is considerable yet the outcome is uncertain. Kelly and Dumm in their series found that of three patients whose incontinence was complete none was cured. In the writer's patient it could be demonstrated by the catheter at the time the Kelly operation was done that the vesical neck was tightened yet it was manifest very shortly after she left the hospital that the repair had given away.

Obviously the important principle of rest to the part is not applied when the healing vesical neck is expected to continue to function. If this indication is met by an indwelling catheter or repeated catheterizations the distention of the repaired orifice seems equally hazardous to a satisfactory outcome.

The value of functional rest in intestinal surgery is well understood and practised and needs no detailed discussion here.

Davis,[2] reporting a successful case of female epispadias, says: "It is remarkable that in not one of the cases operated upon up to 1923 is there any mention of a diversion of the urine by means of a drainage tube in the bladder. In some cases the patients were left to pass their urine over the freshly sutured field of operation and in others a retention catheter was left in place for a certain length of time. This seems remarkable inasmuch as other surgeons who had been operating on urethral defects in the male, particularly hypospadias, had long before this discovered that diversion of the urine is absolutely necessary in order to secure healing in a sufficiently large proportion of cases. Young first put this principle into effect in 1923."

H. H. Young [14] described cures in cases of incontinence following perineal prostatectomy as well as in a case of epispadias by an internal sphincter repair through the bladder, and external sphincter repair through the perineum, combined with bladder drainage.

Lowsley,[15] in an article on incontinence, reported a woman with relaxed sphincter following childbirth in whom he repaired the sphincter through the bladder with bladder drainage as in Young's operation for epispadias. She had in addition a small vesico-vaginal fistula requiring closure.

On searching the literature since the appearance of Kelly's operation on relaxation of the vesical sphincter in women there is almost no mention of extraurethral bladder drainage. Stoeckel [8] is a notable exception. In his textbook he states that in all cases where the urethra or bladder neck is operated upon bladder drainage, preferably infrasymphyseal, by a catheter introduced through a trocar, should be practised as an intraurethral catheter must press on the sphincter sutures and disturb healing mechanically.

Mikulicz-Radecki,[16] of Stoeckel's clinic, has used this principle in part of his cases. Lowsley's case has already been cited.

To my mind suprapubic drainage seems preferable to infrasymphyseal because it aids in the dissection and closure of the vesical neck to have a guiding finger in the bladder. One reason I think for hesitancy in the use of suprapubic bladder approach and drainage is that it seems to add a considerable procedure to an operation often successful without it. As to the hazard, I believe it is little increased, although convalescence will be somewhat longer than after plastic procedures alone, a small price to pay for a successful outcome.

It is manifestly unwise to urge an operative plan on the basis of one case. Furthermore in this patient reported it must be conceded that a second attempt at a Kelly repair without drainage of the bladder might well have been successful, particularly with the addition of the interposition. On the

other hand the principle of securing rest by temporary diversion of the urinary flow is of unquestioned value and in the writer's opinion its application in this case was an important factor in the satisfactory outcome.

CONCLUSION

A careful plastic repair of the anterior vaginal wall with such other gynecological procedures as may be indicated will correct the impaired bladder control of which many of these sufferers complain in the majority of instances. When the incontinence is more pronounced the Kelly operation of tightening the vesical sphincter combined with colporrhaphy gives a cure in a considerable proportion of women with relaxed vesical sphincter. Where this procedure failed in a case of severe incontinence the addition of bladder drainage to the plastic on the sphincteric region supplemented by an interposition gave an excellent result. In view of the apparent neglect of the principle of temporary diversion of the urine in the repair of relaxed vesical sphincter in parous women this report is offered with the hope that it may be of use in similar situations and perhaps obviate the necessity of employing more complicated procedures.

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THE SURGICAL TREATMENT OF GENITAL ELEPHANTIASIS IN THE MALE

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Filarial elephantiasis is rare in the continental United States, but cases of lymph scrotum and penis appear occasionally, due usually to lymph block following extensive inguinal inflammation. Practically all of the cases seem to be complicated by a low-grade streptococcus infection in the œdematous tissues, which may give rise to acute inflammatory reactions of greater or less severity and at varying intervals. The victims of this condition are greatly troubled by it, and all wish for relief. Surgeons in tropical countries have, as a result of extensive experience, formulated the conditions of surgical treatment and their conclusions are equally applicable to the cases occurring here.

The fundamental principle is that of complete removal of all affected tissues. This usually means the entire area drained exclusively by the inguino-femoral lymph-nodes; namely, the scrotum and penis, and sometimes limited zones in the presymphyseal and anterior perineal areas. The glans penis and inner leaf of the prepuce are usually unaffected, since their lymphatics anastomose with those of the urethra, and in the same manner the testes, epididymes, and spermatic cord usually escape, having their own drainage into the pre-aortic nodes. Some degree of hydrocele is, however, not infrequently present.

There is an intense œdema of the subcutaneous tissues giving an appearance of transparent, gelatinous masses. The overlying skin becomes thick, rough and brawny, and is often dusky or purplish in color. The streptococcus infection may cause the skin to be intensely red and inflamed, even weeping. The weight of the enlarged scrotum may drag normal areas of skin from either side of the perineum, or even from the thighs, down so that it forms part of the lateral aspects of the upper part of the scrotum. This skin, if present, and the inner layer of the prepuce, may be used to help cover the defect left after operation. All other skin and subcutaneous tissue showing even the slightest sign of involvement must be ruthlessly cut away. The only organs to be carefully spared are the urethra and corpora cavernosa, the testes and their appendages, the spermatic cords, and the dorsal vessels of the penis. The tunica vaginalis should be split and turned back over the spermatic cord ("bottle operation") to avoid the possibility of a subsequent hydrocele. It is surprising how well the penis and testes can usually be covered by drawing up the adjacent normal skin, but if this is impossible, the testes are simply to be tacked to the perineum. They and the penis can then later be covered by skin grafts.

The vascular supply to the enlarged organs is usually much increased.

Bleeding has caused many surgeons to recommend doing the operation with the aid of a tourniquet passed around the base of the scrotum. It is, however, quite simple to clamp and cut the vessels as one proceeds, and the tourniquet may be much in the way.

Very great enlargements of the scrotum may surround and enclose the penis, until one can see nothing of it but a deep dimple on the anterior surface of the scrotum. In such cases the dimple must be split up to find the penis.

Sir Havelock Charles,* of Calcutta, advises an operation almost exactly as described above. He uses no tourniquet, makes his incision in healthy skin, regardless of where it may lead him, and undermines the skin of each side of the perineum to allow it better to be drawn over the defect. He uses skin grafts if necessary.

H. W. L. Waller† substitutes for the tourniquet a clamp made of two straight pieces, one lying in front of the scrotum, the other behind. These pieces are drawn together by screws passing one on each side of the scrotum. He makes a horseshoe incision on the anterior surface of the mass, its limbs parallel and directed upward, and joined below the penile dimple. This gives a horseshoe flap which he uses to cover the penis. One would think that in many cases the skin in this region would be œdematous and unfit for such a purpose.

Sir Douglas Manson‡ uses a tourniquet arranged as in the accompanying diagram (Fig. 1). This arrangement exerts lateral pressure on the scrotum and allows the tourniquet to be placed higher than if it simply encircles the base of that organ. He insists upon the importance of removing all diseased tissue, cutting in healthy skin, and paying no attention to the possibilities of repair until excision is complete, since if there is insufficient skin, skin grafting is easy and satisfactory.

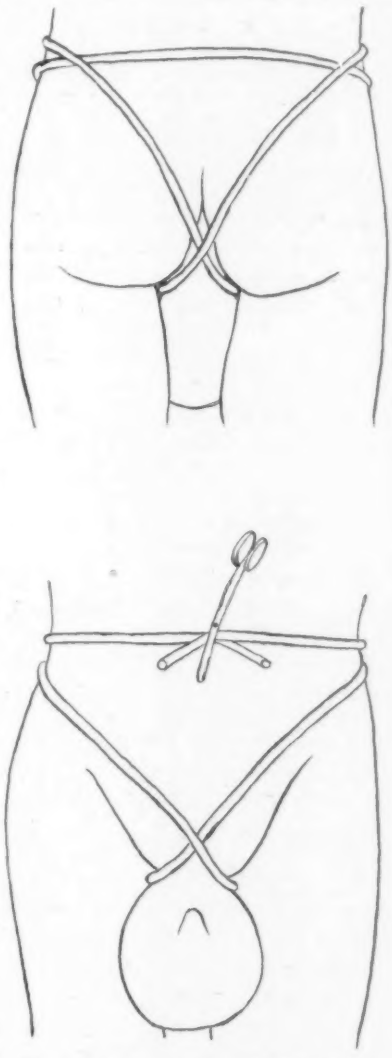

FIG. 1.—Manson's method of applying tourniquet before operating upon scrotal elephantiasis.

Hugh H. Young in this country reported a case in his "Practice of Urology," in 1926. He used no tourniquet and removed the very large scrotum radically, but even so was able to cover the raw surfaces completely

* Quoted by McCaw, Keen's Surgery, vol. iv, p. 1120, 1914.

† Lancet, vol. ii, pp. 1132-1133, 1923.

‡ Tropical Diseases, 8th edition, 1925.

and did not have to resort to grafting. The retracted inner layer of the prepuce covered practically the entire penis.

The two case reports following represent moderate-sized enlargements. The first was the larger, and an excellent result was obtained following operation. In the second, the œdema affected only the penis and the anterior two-fifths of the scrotum, but conservatism engendered by this limited involvement led to an incomplete procedure, and a second operation was necessary to complete the cure.

Case I.—W. G. W., aged forty-three, entered the Strong Memorial Hospital, Rochester, N. Y., September 28, 1927. The family history was negative. In the past history were pleurisy on the right sixteen years previously, and more recently a good deal of trouble with the right foot and ankle, consisting of arthritis and osteomyelitis following an injury. Twenty years previously there had been some genito-urinary disease. The patient stated that he remembered it only vaguely, but it appeared that there was some urethral discharge, followed by an abscess in the right inguinal region, which was opened and drained. There was no history of a genital sore. Two years before admission, itching and burning of the scrotal skin commenced, followed a week later by swelling. Rest in bed, catharsis, and cold applications reduced the swelling, but it returned on arising, and continued to increase slowly but steadily for two years, involving the penis as well. Examination showed extensive scarring in the right inguinal region, but, surprisingly enough, none on the left. The left inguinal nodes were somewhat enlarged. The scrotum measured sixteen centimetres long and thirty centimetres in circumference. The penis was about four centimetres in diameter. The skin over the scrotum was thickened and brawny, that over the penis almost normal. The Wassermann and Kahn tests were negative, the blood count and differential normal. The blood-pressure 105/80. Repeated examinations for filaria in the blood were negative.

Operation was performed October 25, 1927. In view of the comparatively slight involvement of the penis, it was decided not to operate upon it. Some normal skin on each side of the scrotum was saved. Posteriorly the incision passed four and one-half centimetres in front of the anus. The lateral flaps were undermined to remove all of the œdematous tissue, and at the end, the bulbous urethra was entirely exposed. A bottle operation was done on each testis. The lateral flaps allowed the defect to be completely covered. One small rubber tissue drain was placed at the posterior angle of the incision and closure was by skin clips. Streptococci were found in the tissue removed. The patient left the hospital sixteen days later. He was seen two months after discharge at which time the wound was entirely healed. The penile œdema was markedly decreased, and intercourse was satisfactory. The new scrotum looked the same as at the time of discharge from the hospital, that is, considerably smaller than normal. He considered himself cured.

Case II.—J. B., aged forty-two, admitted to the Brady Urological Institute, Johns Hopkins Hospital, March 20, 1929. The family history was negative. The past history was also negative, except for matters concerning the present illness. About 1909 there was an attack of gonorrhœa. About 1911 there was a penile sore, accompanied by bilateral suppurative inguinal bubo, both sides being incised and drained. In 1913, there was an attack with constipation, malaise, general lassitude, chill, fever, swelling of the anterior part of the scrotum and of the penis, reddening of the skin, and difficulty of voiding due to swelling. This attack lasted several days. Such attacks continued to occur about every six to twelve months, and the swelling remained between attacks and increased gradually. On several occasions the patient made incisions in the scrotum to relieve the tension. Examination was negative except for the genitalia. There were extensive scars in both groins. The penis was swollen, œdematous, dusky and cyanotic,

FIG. 2.—Case II. Photograph of genitalia before first operation. Note scars of self-inflicted incisions.

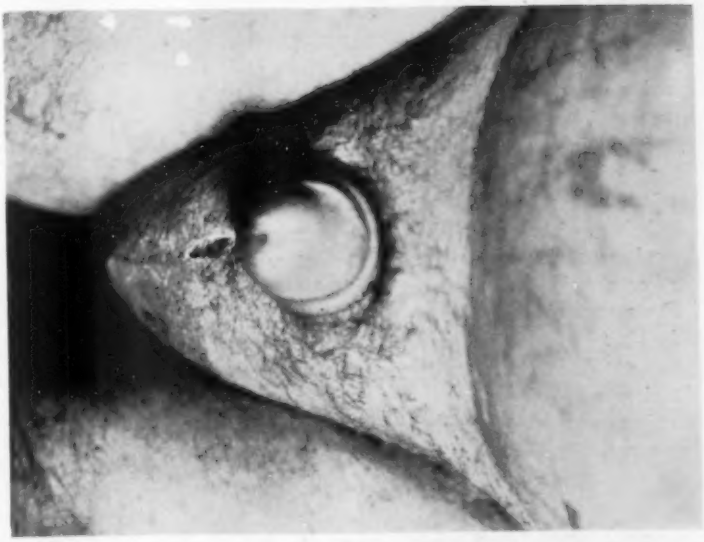

FIG. 3.—Case II. Photograph made shortly after first operation.

FIG. 4.—Case II. Photograph made seven months after second operation. Note normal scrotum, slight oedema of prepuce.

blanching on pressure. The skin was definitely thickened. The inner layer of the prepuce was normal. A similar change involved slightly less than the anterior half of the scrotum. In the upper part on the right were linear scars of the incisions the patient had made. The testes and epididymes were normal (Fig. 2).

Operation was performed March 22, 1928. A bottle operation was done on each testis. All œdematous tissue was removed from the scrotum and penis, and all the thickened skin except small areas of slightly involved skin on each side of the scrotum and at the base of the dorsum of the penis. It was hoped that collateral lymph circulation would take care of these, allowing a more perfect plastic repair. The inner layer of the prepuce served to cover the penis. The excision was done with the radio knife. One small drain was placed and closure was by plain catgut sutures subcutaneously drawing the halves of the scrotum together, with fine black silk to the skin. The specimen measured fourteen by four and one-half by six centimetres, and weighed 154 grams. The patient left the hospital in about two and one-half weeks (Fig. 3).

The result appeared to be good for a month, when another typical attack occurred, involving the areas of abnormal skin left behind at the operation at the base of the penis and on the left side of the scrotum.

A second operation was therefore performed August 30, 1929. The plan was similar to that employed at the first operation, except that it was more radical, the incision passing everywhere through normal skin and all tissue that was even suspicious being removed. The inner layer of the prepuce was still good and again served to cover the penis. In order to prevent it sliding forward, it was anchored dorsally to the periosteum of the symphysis pubis, and ventrally to the tunica albuginea of the bulb of the urethra, using fine chromic catgut. The halves of the scrotum were drawn together as before. The patient left the hospital eighteen days later.

The result was observed seven months later. The patient felt very well, and had had no further attacks. The scrotum looked almost normal. The penis was free, and appeared like a normal penis except for a little ring of soft œdema behind the coronary sulcus. The skin was not thickened. The photograph (Fig. 4) shows the organs at this time. It does not do justice to the penis which, when drawn up, was fully five centimetres long in the clear while flaccid.

The patient was again seen June 15, 1930. No further attacks. The preputial œdema has practically disappeared.

TORSION OF THE SPERMATIC CORD IN INFANCY

By Edward J. Donovan, M.D.
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The infrequency with which torsion of the spermatic cord is found in infancy leads me to report the three following cases operated upon by me at The Babies Hospital in 1928. The only case previously reported from The Babies Hospital was operated upon by Doctor Farr in 1911. The three following cases were admitted within a period of ten weeks. In 1901 Scudder reported thirty-one cases, all there were in the literature at that time. Two of these were under one year of age. Since that time, 163 cases have been reported, thirteen of which were less than one year old.

Torsion may occur at any age, most of the cases reported having been in young adults of twenty years of age. The youngest case on record is an infant at birth, reported by Taylor in *The British Medical Journal* in 1897. This child was operated upon two days later and the testicle found gangrenous. The cases reported here were eight, eight and ten months of age. The condition seems to be much more frequent in incompletely descended testes and somewhat more common on the right side. Two of my cases were on the right side, the testis being found in the inguinal canal in each. In two of them an indirect inguinal hernia was found, neither sac communicating with the tunica vaginalis.

The exact cause of torsion is unknown, but nearly every author has reported some abnormality in the attachment of the testis to the cord and epididymus. The most common findings are a capacious tunica vaginalis and either a long or broad mesorchium. A brief review of the embryology shows that the testicle and epididymus develop as separate structures, retroperitoneally, at the lower pole of the kidney, each with a separate mesentery attaching it to the posterior abdominal wall. The mesorchium is the original mesentery of the testicle and ceases to exist when the two mesenteries fuse as they normally do at about the fourth month of intrauterine life. With an unobstructed passage the testis and epididymus reach the scrotum by the ninth month of fœtal life. When there has been some interference with this fusion and passage to the scrotum, it is not uncommon to find a long mesorchium or a wide separation of testis and epididymus. Great variations in the attachment of the spermatic cord to the testis have been reported. These conditions, no doubt, predispose to torsion, and since abnormalities are more common in incompletely descended testes, it is probably for this reason that torsion is more often found where the testis has not reached the scrotum. In two of my cases, necrosis had reached a point that it was impossible to define the mesorchium, but each case showed a large tunica vaginalis.

It has been shown by experimental work that necrosis of the testis

develops if a complete torsion has existed for thirty hours. In my cases, the testes were found to be blue hæmorrhagic masses, the microscopic examination in each case showing advanced necrosis with almost complete loss of the structure of the testicle. The necrosis was less marked in the epididymus.

The most striking thing about these cases was the complete absence of symptoms in two of them. The other patient had been irritable with some vomiting and diarrhœa for three days. None of them looked sick; all were afebrile. All of them were brought to the hospital because the mothers had noticed a mass in the gorin while bathing the babies.

Perhaps the most important points in the diagnosis of torsion are the presence of the inguinal mass and the absence of the testicle from the scrotum on the corresponding side. There may be a change in the color of the skin over the mass, but this was absent in two cases. Fluid may be present in the tunica vaginalis, and, if bloody, may help in the diagnosis. In none of these cases was the tunica vaginalis explored with a needle before operation as I consider the procedure too dangerous, particularly if the mass happens to be a strangulated hernia instead of torsion of the cord. In all of these cases the opposite testis was of normal size and in the scrotum.

The three conditions with which torsion is most apt to be confused are (1) Acute epididymo-orchitis. This condition is so rare in infancy that it is much safer in the presence of the signs to consider the case one of torsion. (2) Strangulated hernia. It is often impossible to differentiate between these two conditions. Since both require immediate operation, there is little point in spending time in an effort to make an exact diagnosis. (3) Acute inguinal adenitis. There will usually be some reason for the adenitis: either an infection of the leg, foot, or anal region, and a change in color of the skin over the mass.

No fatal case has been reported in the literature to date. Atrophy is sure to follow a complete torsion that has been present more than thirty hours. Sloughing and infection have been reported but are the exception rather than the rule. Infection is much more serious if there is an accompanying hernia sac through which the infection may reach the peritoneal cavity.

In complete torsion, if the circulation in the testis does not improve after detorsion and the application of hot pads, the testis and cord should be removed as the danger of infection in this badly damaged testis makes the chance too great to leave it. In incomplete torsion, simply straightening the cord out may suffice. In the above cases, there was no doubt at the time of operation what the best procedure was since necrosis to a rather marked degree had taken place in each case.

Case I.—R. B. T., age ten months, was admitted to The Babies Hospital August 22, 1928, with a history of a swelling in the right groin for two days. Family history entirely negative. Patient was born three weeks prematurely but had shown normal development to date. Mother had noticed a swelling in the right groin two days before while bathing the baby. She had not noticed before that the right testis was not in the scrotum. She stated that the baby had shown no signs of pain nor discomfort either before or since she discovered the swelling. No history of trauma nor infection of

foot, leg or anal region. Physical examination was entirely negative except for the local condition. There was a mass in the right inguinal region three and one-half by two and one-half centimetres, movable, not tender nor attached to the skin. No change in the color of the skin over it; no abdominal muscle spasm; no sign of infection of the neighboring parts. The right testicle was not in the scrotum, the left testis was of normal size in the scrotum. Rectal examination was negative. Urine, negative. Temperature 99; white blood cells 11,800; polynuclears 66; lymphocytes 34. *Diagnosis.—Torsion of the spermatic cord* or strangulated inguinal hernia of right side. Operation.—Right inguinal hernia incision exposed a gangrenous testicle in the inguinal canal with the cord twisted twice in a clockwise direction. Tunica vaginalis contained considerable bloody fluid and was about twice the normal size. Cord untwisted, but circulation failed to return so the cord and testis were removed after transfixing the cord at the internal ring. Microscopic examination (Fig. 1) showed complete destruction of the tubular structures in the testicle and to a lesser degree in the epididymus. Convalescence uneventful. Discharged on the eighth day with his wound healed by primary union. Follow-up: One and one-half years, general condition excellent; incision well healed: free from symptoms.

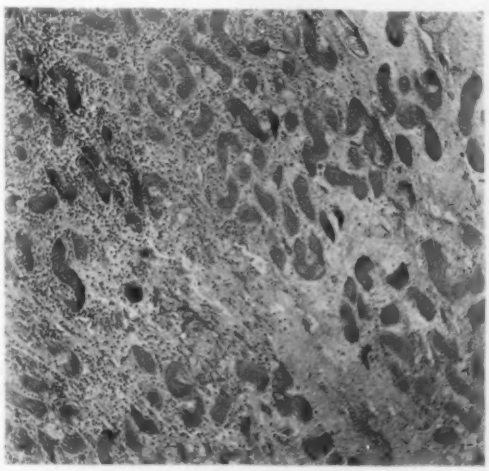

FIG. 1.—Microphotograph of testicle in Case I showing a large amount of hæmorrhage with almost complete destruction of the structure of the testicle.

CASE II.—E. C., age eight months, was admitted to The Babies Hospital October 29, 1928. Complained of being irritable, having a swelling in the groin about four days. Child has been perfectly well to date and had had normal development. Four days previously the mother had first noticed a swelling in the right groin while bathing the baby. Child had done no vomiting and had apparently been in no pain during the four days. Physical examination was entirely negative except for the local condition. There was a mass in the right groin three by two centimetres, firm, fixed and somewhat tender. Skin over it was not changed in color. The right testicle was absent from the scrotum, the left testicle was normal in size and position. There was no infection of the leg nor anal region. Temperature, 100; pulse, 80; respiration, 22. Urine, negative. *Diagnosis.—Torsion of the right spermatic cord.* Operated upon immediately, the testicle being exposed in the inguinal canal through the usual hernia incision. The testicle was about twice the normal size, blue, hæmorrhagic, with the spermatic cord twisted upon itself one and one-half times in a clockwise direction. There was an indirect inguinal hernia sac found when the cord was untwisted, and it was treated in the usual way. As the color failed to return to the testicle after the application of hot moist pads, it was removed with the cord. Convalescence uneventful. Discharged on the eleventh day with the wound completely healed by primary union. Microscopic examination of the specimen removed showed almost complete destruction of structure of the testicle with necrosis less marked in the epididymus. Follow-up: One year, five months, free from symptoms. Incision soundly healed.

CASE III.—F. P., age eight months. Admitted to The Babies Hospital November 3, 1928, complaining of swelling in the left groin, vomiting and diarrhœa for three days. Three days before while bathing the baby the mother had first noticed a swelling in the left groin. Baby had been perfectly well previous to this time, but had diarrhœa and

vomited about three times daily for the following three days. Physical examination: Well-developed, well-nourished, white male infant, eight months of age, irritable, crying and apparently in pain. General examination was entirely negative except for the following: there was a mass in the left inguinal region four by three by two centimetres, firm, fixed and quite tender. Skin over it slightly red. Left testicle absent from the scrotum. Right testicle of normal size in the scrotum. *Diagnosis.—Torsion of the incompletely descended testis.* Immediate operation, the usual left hernia incision exposing a mass consisting of the left testicle, cord and hernia sac twisted on the cord twice in a clockwise direction at the internal ring. Mass was hæmorrhagic, blue, rather densely adherent to the surrounding structures. (Fig. 2.) Upon release of the torsion and application of hot pads there was no change in the color of the testis. The hernia sac was treated in the usual way; the cord ligated at the internal ring and removed with the testicle. Incision closed with interrupted chromic. Convalescence was uneventful. Discharged on the seventh day with the wound soundly healed by primary union. Microscopic examination showed that there was complete loss of the structures of the testicle and epididymus. Follow-up: one year and five months later, incision well healed. Child entirely free from symptoms.

FIG. 2.—Photograph of the specimen in Case III immediately after operation, showing torsion of the cord just above the testicle and separation of the testicle and epididymus. The remnant of the accompanying hernia sac is seen at the upper part.

SUMMARY

1. Torsion of spermatic cord may occur at any age, but it is found most frequently in young adults.

2. It is most often found in incompletely descended testes.

3. Almost all cases show a long or broad mesorchium, a capacious tunica vaginalis or some abnormality in attachment of vas and epididymus to testis.

4. Atrophy of testis usually follows if torsion has been complete for thirty hours.

5. Sloughing and infection of testis may occur but not as frequently as atrophy.

6. Cases reported in infancy may lack the characteristic diagnostic signs found in adults.

7. Torsion must be differentiated from (1) acute epididymo-orchitis, (2) incarcerated inguinal hernia and (3) acute inguinal adenitis.

8. Orchidectomy should be done if circulation does not return after torsion has been corrected and heat applied.

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A DEPENDABLE METHOD FOR SUTURING STOMACH AND INTESTINES *

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An efficacious suture of the severed walls of stomach and intestine fulfills the following immediate, secondary, and ultimate requirements:

Immediate.—Accurate gas and fluid-tight approximation of serosa, subseroa, muscularis, submucosa, the mucosa is accomplished readily and gently with the use of the least amount of suture material compatible with safety; it is so accomplished that even partial obstruction of a viscus or stoma from puckering caused by continuous suture is avoided; only a narrow margin of the walls is included in the suture in order to restrict so far as possible interference with the neuromuscular mechanisms; an adequate blood supply of the margins is preserved to assure healing, yet so controlled as to prevent hæmorrhage into the lumen and intramural hæmorrhage. Moreover, the method should be applicable as a rule to lateral, end-to-side, and end-to-end anastomoses, to the closure of plastic and exploratory incisions.

Secondary.—Primary healing is provided and consequently an early restoration of function, particularly a reëstablishment of the normal gastro-intestinal gradient; an early disruption by peristalsis of entangling adhesions, *i.e.*, other than omental, that must form along the line of suture; and prevention of adhesions to parietal peritoneum.

Ultimate.—Minimal ultimate cicatrization at the line of closure to obviate subsequent marginal ulceration and stenosis of stoma.

In 1920, operations were performed by Thalhimer and Yates[1] upon animals in order to determine by macroscopic and microscopic examinations the accuracy of approximation of layers attainable by various sutures, the nature of the healing at subsequent intervals, and also the completeness of the reëstablishment of functions thereby provided.

Black silk was used as suture material because it could be readily recognized in gross examinations and identified in sections and would thus disclose the most favorable type of suture. It was found that however accurate the immediate approximation of the layers of intestinal wall appeared to be macroscopically, when examined microscopically it was, excepting the serosa,

* Presented before the Milwaukee Surgical Society, May 5, 1930.

[1] The experimental work was done in the laboratory department at Columbia Hospital. Its cost and that of many post-operative observations was borne by a fund for research contributed by individuals and industrial organizations in Milwaukee.

surprisingly inaccurate. Nevertheless, the ultimate healing was quite as surprisingly good in that the layers had become reëstablished.

The following method was adopted because it fulfilled all of the immediate requirements save accurate layer-to-layer approximation which had been found to be unattainable but proved to be unnecessary and all of the secondary and ultimate requirements. Moreover, it fulfilled these requirements as well or better than other methods employed, some more complicated, none more dependable.

1. Approximation of serosæ posterior to the proposed stoma with interrupted silk mattress sutures; the two lateral sutures were beyond the angles of the stoma, left long

FIG. 1.—End-to-side anastomosis. Serosæ posterior to stoma united with interrupted silk mattress sutures. Lateral stitches left long, grasped in forceps, and counter traction applied to prevent puckering. Serosa, subserosa, and muscularis incised exposing submucosa, the incision not extending to lateral mattress sutures. Serosa, subserosa, and muscularis being approximated snugly with a continuous over-and-over catgut suture which includes the submucosa and provides hemostasis in structures external to submucosa.

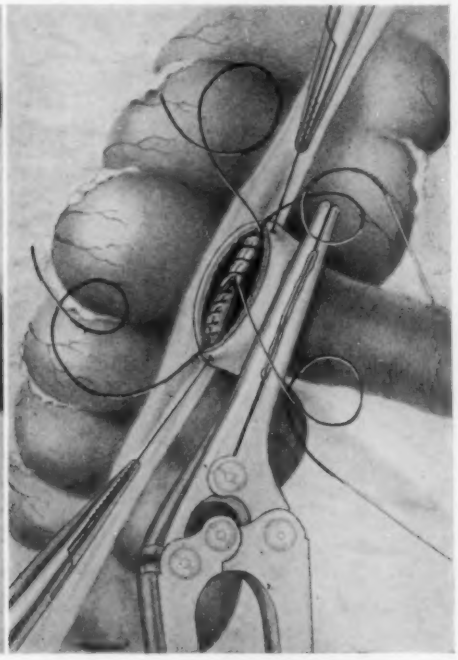

FIG. 2.—End-to-side anastomosis. Submucosa and mucosa have been divided close to preceding sutures (Fig. 1.) and open the lumens of the bowels. A continuous over-and-over suture is being inserted to unite posterior margins of mucosa and submucosa. Every third stitch includes the margins approximated by the sero-muscular suture and locked. Each stitch is drawn snugly to provide hemostasis in the layers internal to the submucosa.

and held taut so as to obviate contraction by the continuous sutures to be inserted and drawn snugly to prevent hæmorrhage. (Fig. 1.)

2. Incision of serous, subserous and muscular layers down to the submucosa one-half centimetre from and parallel to the row of interrupted sutures but not extended to the lateral sutures. (Fig. 1.)

3. A continuous over-and-over catgut (Dulox) suture is employed to approximate the posterior margins of the serous and muscular layers exposed by the incision. (Fig. 1.) The first stitch is inserted at one angle of the incision, tied, and its end left long to be tied again when the suture (Paragraph 8, Fig. 4) of the anterior margin is completed.

The stitches include the submucosa to give the backing needed to prevent their pulling out when drawn snugly and to compress the margins of the muscular and serous layers against the submucosa, thus providing for effective hemostasis in layers external to the submucosa and against the formation of dead space. The last stitch is locked and is not cut.

4. Incision of mucosa and submucosa close (0.5 centimetres) to the previous suture and, if necessary, aspiration of contents from the lumens of the viscera which are now opened.

5. A continuous over-and-over catgut (Dulox) suture approximates the posterior margins of the mucosa and submucosa. The first stitch is inserted at the angle opposite

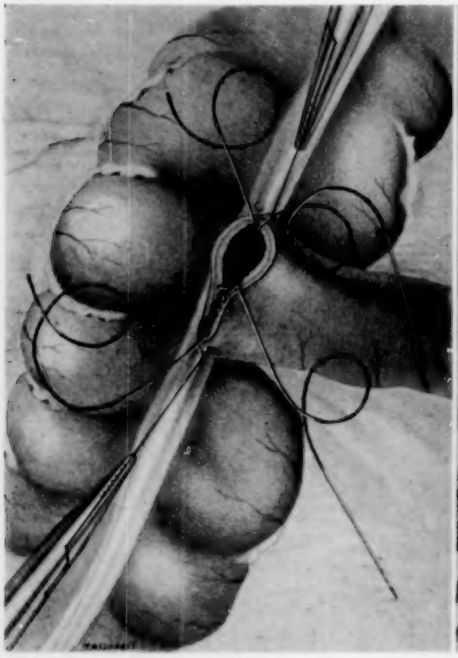

FIG. 3.—Anterior portion of the wall of the ileum has been divided at a suitable distance from the crushing clamp. The over-and-over suture used to unite the posterior margins of the mucosa and submucosa is now continued as a baseball stitch to approximate their anterior margins. Each stitch is drawn snugly to provide gas and fluid-tight closure and to prevent hæmorrhage from these structures.

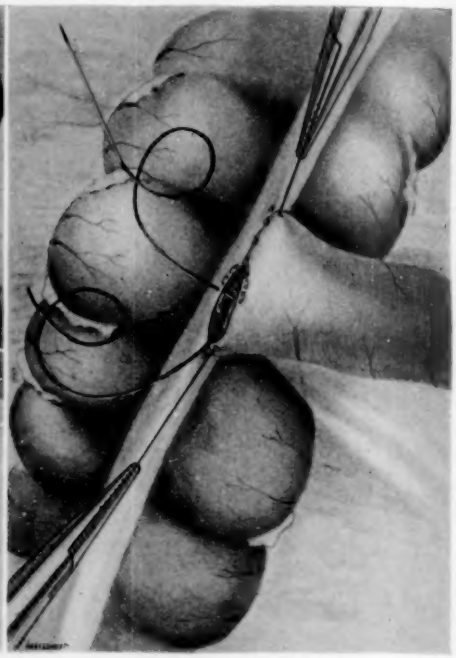

FIG. 4.—End-to-side anastomosis. The continuous over-and-over catgut suture used to unite the posterior margins of serosa, subserosa, and muscularis now being utilized as a Cushing stitch to approximate their anterior margins and to provide hemostasis in the layers external to the submucosa.

to that in which the previous stitch began. (Fig. 2.) Every third stitch includes the margins approximated by the previous stitch (Fig. 1, Paragraph 3) and is locked to prevent slipping. Each stitch is drawn snugly to provide hemostasis in the layers internal to the submucosa and to obliterate dead space.

6. Division of anterior portions of walls which have been unsevered in end-to-end and in end-to-side anastomoses and trimming of redundant mucosa in lateral anastomoses. Clamping of such vessels in the anterior wall as bleed profusely and sometimes ligating such as threaten to continue to bleed. This is commonly unnecessary and should be avoided when safe as the ligatures, even of fine catgut, add an undesirable bulk of foreign body.

7. Continuing the mucosa-submucosa stitch (Fig. 3, Paragraph 5) to unite the anterior layers as a baseball stitch (Fig. 3) which affords sufficiently accurate approxi-

mation to assure healing. It is more efficacious in producing unleakable closure and in providing hemostasis than an over-and-over stitch and more easily inserted than others. It is tied to the end left long when the first stitch was inserted in the closure of the posterior margins of the mucosa-submucosa layers.

8. The continuous over-and-over catgut suture (Fig. 4) employed to unite the sero-muscular layers is now utilized as a Cushing stitch to approximate the anterior serosa, subserosa, muscularis, and submucosa. It is tied to the end left long when the first stitch was inserted in the layers posteriorly.

9. Approximation of serosæ anteriorly with interrupted silk mattress sutures. (Fig. 5.) These sutures and the posterior row (Fig. 1) may be omitted if exposure is inadequate or if an emergency demands speed. They add a factor of safety so that the time required to insert them is usually well spent.

10. Approximation of the margins of the apertures in mesentery.

11. Wrapping omentum about the line of intestinal suture.

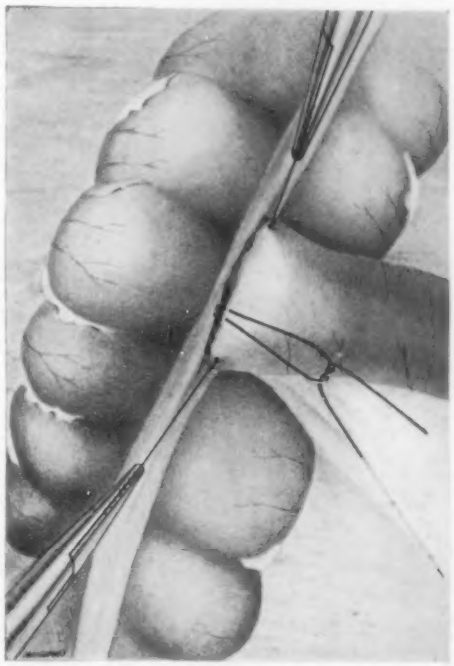

FIG. 5.—End-to-side anastomosis. Suture being completed by approximating the serosæ anteriorly with interrupted silk mattress sutures.

Illustrations show steps in the application of this method to an end-to-side anastomosis between small and large intestine when the intervening portions of the bowel are to be excised. In the drawing the colon is undivided while the anastomosis is being accomplished. In operations the colon is previously divided, the distal end is ligated after crushing and inverted with two purse-string sutures. The anastomosis is made close to this stump and imitates normal ileocecal relationships and function.

Clamps are employed only for crushing. Those applied to ends that are to be sutured are so placed perpendicular to the mesentery as not to interfere with the blood supply. If an end-to-side anastomosis is to be made, the lateral margins of the intestine are first drawn apart by Allis forceps applied to the walls distal to where the crushing clamp will be placed, thus assuring that the stoma will be as large as the lumen of the bowel will require. End-to-end anastomoses are performed in a similar fashion unless the bowels to be united differ materially in size. Then the larger segment is puckered before being clamped to reduce the disproportions that must be overcome through unequal spacing of the stitches.

Clinical Aspects.—Patients operated upon during the past ten years have been followed as closely as possible and, when feasible, have been subjected to barium X-ray examinations at subsequent intervals.

One death resulted from necrosis of the ileum at the margin of an ileocolostomy stoma which had resulted from thrombosis of a vein. No other death resulted from faulty healing. The inverted stump of the colon in another patient leaked (proved by X-ray) but as a drain had been employed,

was harmful only in retarding convalescence. The fistula closed spontaneously. Anastomoses in the recto-sigmoid, whether lateral, end-to-side, or end-to-end, seem destined to leak but also to close spontaneously. Otherwise immediate healing has been good.

In patients examined fluoroscopically, some repeatedly, there has been found no evidence of retardation of the progress of the barium at the site of operation, or of local tenderness suggesting the presence of ulcers or manifestations of undue cicatrization. Those subjected to subsequent laparotomy have been found to have no more adhesions than were warranted, some less. The margins of the stomas were soft and pliable and the bowel proximal to the stomas was free from the hypertrophy that would indicate partial obstruction.

NON-EFFECT OF IRRADIATED ERGOSTEROL IN THE TREATMENT OF FRACTURES *

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of New York, N. Y.

FROM THE FOURTH SURGICAL DIVISION OF BELLEVUE HOSPITAL

Following the work of Windhaus, Hess and others in the use of irradiated ergosterol [1] in tetany and rickets, where its action is almost specific, the question arose as to the possibilities of this drug in the treatment of fractures. Would it have any effect upon raising the blood calcium and blood inorganic phosphorus above normal, and would it hasten the deposition of callus at the site of fracture?

Irradiated ergosterol is a substance produced by irradiating ergosterol with ultra-violet light and the consequent production of Vitamin D. The product that we have used was supplied to us through the courtesy of the Winthrop Chemical Company. A careful study was made of a series of seventeen cases of various fractures in adults, most of them fractures of the shafts of the long bones. The reason for selecting fractures of the shaft was because it was felt that callus formation could be more carefully observed in the X-rays of the shafts, and because in case of excessive callus formation, it would be best not to have it too near a joint. The majority of the patients were in the hospital during the entire period of treatment, but some were ambulatory and were studied on their return each week to the divisional fracture clinic.

Table I

Effect of irradiated ergosterol on the calcium and inorganic phosphorus of the blood in cases of fractures in adults estimated in milligrams per hundred cubic centimeters

Case	Date	Age	Ca Before	Ca During	P Before	P During
(1) I. R.	11–26–28	41	10.22		2.10	
	12–13–28			10.20		2.00
	12–26–28			11.22		2.30
	1–21–29			13.64		1.95
(2) K. F.	11–13–28	58	11.20		2.20	
	12–12–28			11.22		2.20
	12–26–28			12.75		2.50
	1–23–29			13.13		2.00
(3) A. K.	12– 3–28	35–40	10.20		2.10	
	1–23–29			10.70		2.10
(4) J. H.	11–26–28	36	11.10		....	
	12–12–28			11.20		1.80

* Read before the Surgical Section of the New York Academy of Medicine, May 2, 1930.

TABLE I (*Continued*)

Case	Date	Age	Ca Before	Ca During	P Before	P During
(5) J. C.	12–19–28	64	13.13		2.75	
	1–23–29			11.80		2.00
(6) A. McG.	12–26–28	55	12.95		3.40	
	1–23–29			11.80		1.80
(7) M. M.	1–30–29	60	12.75		2.00	
	2–11–29			13.26		2.00
	2–25–29			12.75		2.10
	3–13–29			13.26		2.00
(8) D. H.	2–25–29	70	11.75		2.00	
	3–11–29			11.72		2.12
	3–25–29			13.20		2.00
	4–15–29			12.75		2.10
(9) J. R.	3–11–29	28	12.24		2.00	
	3–26–29			11.22		2.50
(10) P. H.	2–11–29	25	12.75		2.10	
	2–20–29			13.26		2.00
	4– 1–29			12.24		2.00
	4–15–29			13.26		2.00
(11) L. R.	2–28–29	35	12.20		2.00	
	3–11–29			12.24		2.00
	3–25–29			12.75		2.10
	4– 1–29			10.67		2.20
(12) P. G.	3–25–29	75	12.75		2.10	
	4– 1–29			12.24		3.25
	4–15–29			11.72		2.50
(13) L. L.	3–25–29	48	13.26		2.00	
	4– 1–29			13.26		2.00
(14) F. G.	3–11–29	43	11.73		2.00	
	3–25–29			13.26		2.10
	4– 1–29			12.75		2.67
	4–15–29			12.75		2.10
(15) A. M.	4– 1–29	15	13.26		2.60	
	4–15–29			13.26		2.77
	4.29–29			12.75		2.50
(16) M. G.	4–15–29	66	11.22		2.00	
	4–29–29			11.22		2.10
(17) C. McC.	4–15–29	58	12.24		2.27	
	4–29–29			12.75		2.20
	5– 6–29			12.75		2.50

X-rays were taken immediately upon admission of the patient, together with a specimen of the blood for estimation of the blood calcium and inorganic phosphorus. As soon as proper reduction of the fracture had been obtained, the patient was started on a daily dose of three and three-tenths milligrams of irradiated ergosterol in olive oil. The ergosterol was given daily for a period ranging in some cases from thirty to seventy days. At weekly intervals X-rays were taken, and determination of the calcium and inorganic phosphorus in the serum were made.

Tisdell's method was used for the determination of the calcium in the blood serum [2] and the method of Benedict and Theis [3] was used for the determination of inorganic phosphorus.

TABLE II

Treatment, type and duration of fracture

Case	Date of Injury	Type of Fracture	Treatment	Irradiated Ergosterol		Fibrous Union	Bony Union
				From	To		
(1) I. R.	11–17–28	Shaft femur shaft tibia both bones at ankle	skeletal traction	11–26–28	1–21–29	5–1–29	7–3–29
(2) K. F.	11–1–28	fracture neck left femur	Whitman abduction spica	11–13–28	1–26–29	12–30–29	3–10–29
(3) A. K.	11–29–28	shaft left humerus	skin traction	12–3–28	1–8–29	12–31–28	3–5–29
(4) J. H.	12–30–27	upper third left tibia and fibula	plaster cast	11–26–28	12–12–28	9–17–28	6–11–29
(5) J. C.	12–16–28	fracture both bones right leg	reduction immobilization, plaster cast	12–22–28	2–1–29	2–1–29	left hospital, not followed
(6) A. McG.	12–20–28	upper third shaft left humerus	skin traction	12–26–28	2–19–29	1–25–29	2–6–29
(7) M. M.	1–27–29	shaft left humerus	skin traction	1–30–29	3–13–29	3–9–29	3–20–29
(8) D. H.	2–23–29	shaft right tibia and fibula	reduction immobilization, plaster cast	2–25–29	4–26–29	4–31–29	5–6–29
(9) J. R.	3–5–29	supracondylar fracture right humerus	skin traction	3–11–29	3–28–29	3–17–29	4–22–29
(10) P. H.	2–8–29	fracture left ulna	reduction immobilization	4–1–29	4–15–29	4–20–29	5–13–29
(11) L. R.	12–7–28	fracture left patella	immobilization, posterior plaster splint	2–28–29	4–1–29	5–2–29	never obtained bony union
(12) P. G.	3–23–29	supracondylar fracture femur	plaster cast	3–25–29	4–26–29	4–24–29	left hospital, not followed

TABLE II (*Continued*)

Case	Date of Injury	Type of Fracture	Treatment	Irradiated Ergosterol		Fibrous Union	Bony Union
				From	To		
(13) L. L.	2–11–29	fracture left ulna	reduction immobilization	3–25–29	4–15–29	4–1–29	5–13–29
(14) F. G.	3–8–29	supracondylar fracture femur	Steinman pin, skeletal traction	3–11–29	5–27–29	5–14–29	6–30–29
(15) A. M.	3–7–29	both bones of forearm	reduction molded plaster splint	4–1–29	4–29–29	4–1–29	4–22–29
(16) M. G.	4–10–29	shaft tibia and fibula left leg	Steinman pin, skeletal traction	4–15–29	5–27–29	5–6–29	6–7–29
(17) C. McC	4–1–29	supracondylar fracture femur	Steinman pin, skeletal traction	4–15–29	5–7–29	5–6–29	7–10–29

Discussion.—As is shown in the preceding table, seventeen cases of fractures have been studied. In none of these cases was it found that irradiated ergosterol had initiated or influenced either the degree or rapidity of calcification. Callus formation, both as judged from the clinical standpoint and from X-ray studies, took about the same amount of time as would be expected normally of a fracture of that type. There was no hastening of the union of the fracture in any case nor could an increased amount of callus deposition be observed in any of the X-rays.

Chemical studies of the blood of the patients were made at weekly intervals for periods varying from thirty-five to sixty days during which time irradiated ergosterol was constantly administered. It will be seen from the table that the inorganic phosphorus did not materially change in amount during treatment. The calcium, however, showed a slight but definite increase in some of the cases. Using the results where treatment was given for the longest periods, we find the following increases in calcium in milligrams per hundred cubic centimetres:

I. R.	10.22.....	13.64	plus 3.42
K. F.	11.20.....	13.13	plus 1.93
M. M.	12.75.....	13.26	plus 0.51
D. H.	11.72.....	12.75	plus 1.03
P. H.	12.75.....	13.26	plus 0.51
F. G.	11.73.....	12.75	plus 1.02
L. R.	12.20.....	10.67	minus 1.53

In all of the above, except L. R., there is a slight increase in the calcium. According to Tisdell and Harris,[4] however, these increases are within normal

range, as they found, in studies of a year's duration on healthy adults, that calcium and phosphorus retention does not run parallel, and also that certain definite and important changes in the inorganic metabolism almost always accompany any process of bone repair. Therefore, it is questionable whether the increase as noted can be attributed to the influence of the irradiated ergosterol which was administered.

Outside of the medication the fractures were treated in our accustomed manner. Four cases of fracture of the shaft of the femur were treated with skeletal traction with a Steinman pin just above the condyles of the femur, followed by a plaster spica, and then with weight bearing, in some cases with an ambulatory Thomas's splint. Two cases of fractures of both bones of the leg with marked overriding were treated by skeletal traction with a Steinman pin inserted through the os calcis, followed by a plaster case as soon as fibrous union had occurred. Four cases of fracture of the humerus were treated by skin traction with mole skin, and one case of fracture of the patella with only slight separation of the fragments was treated by immobilization for six weeks with a posterior molded plaster splint.

One case of fracture of the neck of the femur (K. F.) was followed with special interest. The usual Whitman abduction method of reduction and immobilization in a plaster spica was followed. No increase in the rapidity of callus formation could be noted. Unfortunately, this case was transferred to another hospital and was lost sight of after the first ten weeks.

The remaining cases were reduced at the time of admission and immobilized in plaster.

All cases were given occupational therapy following the period of immobilization.

Cases of delayed union.—In this group there were six cases that may be considered ones of delayed union. Four of these were fractures that had been present for periods varying from six weeks to eleven months before irradiated ergosterol was started, and in all of which no bony union had occurred. In none of these cases was there any deposition of bony callus during the administration of the medication, either clinically or by X-ray study. These four cases are as follows in Table II:

Case No. 4.—Fracture of upper third tibia and fibula. Present for eleven months before medication. Only fibrous union.

Case No. 10.—Fracture left ulna. No union after fifty-one days. No effect from medication.

Case No. 11.—Fracture of patella. Not operated upon because of skin abrasions and contusions. No union after two and a half months. No effect from medication.

Case No. 13.—Fracture left ulna. No union after six weeks. No effect from medication.

Two cases in this group were ones in which the treatment was started shortly after the fracture occurred and in both of which delayed union occurred anyway. Case No. 1 was kept on the irradiated ergosterol for two

months with no apparent result and bony union did not occur for nine months. This patient had three separate fractures, as is shown in Table II.

Case No. 3 was a fracture of the lower third of the shaft of the left humerus. Treatment was started immediately and medication was continued for about five weeks with no result. Ultimate bony union did not take place until March 5, 1929.

It can, therefore, be seen that whether the delayed union was already present or whether it was a subsequent finding, no benefit was obtained from the use of irradiated ergosterol. Wassermann reactions in all of these cases were negative and there were no factors that could be found as etiological factors in the cause of the delayed union.

CONCLUSION

1. Irradiated ergosterol does not hasten union or callus formation in fractures in adults.

2. Irradiated ergosterol does not materially raise the calcium and inorganic phosphorus in the blood of adults suffering from fractures. An average rise of only 1.4 milligrams of calcium was obtained and the phosphorus showed relatively no change.

3. Delayed union was present in six cases and no benefit was obtained by using irradiated ergosterol.

4. Irradiated ergosterol cannot be considered of value in the treatment of fractures in adults whether union be delayed or not.

(My thanks are due to Miss Florence S. Tabor who did the blood chemistry work involved in the above studies.)

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INTRAARTICULAR ENDOTHELIAL TUMORS ARISING FROM SYNOVIAL MEMBRANE

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FROM THE THIRD SURGICAL DIVISION OF THE RUPTURED AND CRIPPLED HOSPITAL

Definitely encapsulated tumors arising from within joints are rare occurrences. A careful search of the literature reveals few instances that have been reported and none have been reported with a complete pathological diagnosis with suggestions as to origin and treatment.

Classification.—The etiology is obscure but these tumors are considered as neoplasms. Syphilis, tuberculosis and focal infection or blood diseases

Fig. 1.—X-ray showing soft tissue shadow definitely outlined filling anterior space of knee-joint.

Fig. 4.—X-ray of ankle showing soft tissue tumor in anterior space of ankle-joint.

such as anæmia, leucemia, etc., can be ruled out, as the patients are apparently in the best of health. The blood chemistry with special attention directed to cholesterin showed no variation from the normal. Trauma is not considered a factor in the etiology of these tumors but can produce secondary changes in the joint, due to pressure or invasion of the adjacent structures by their slow growth. They are considered primary in the joint as they show no involvement of the lymph structures or in other parts of the body.

Pathology.—When one explores a joint so affected, the cartilage and ligaments intact, one is impressed to find a tumor that has adapted itself

to the shape of the joint-space it occupies. The tumors are definitely encapsulated and their only attachment is to the synovial membrane. They have a yellow and brownish tinge as to color, resembling the color of synovial membrane, and to the touch they are resistant as in kidney tissue, therefore very cellular. On cut surface (Fig. 5) the increased pigment is shown near the center in small islets. The histological picture (Figs. 3 and 6) shows the tumor composed of peculiar, elongated, blunt cells, sometimes fusiform in shape, lying closely together. The nuclei are round and oval in shape. In certain zones the fibrous tissue seems to exceed the cellular elements. Numerous mitotic figures are noted and one would think we are dealing with an atypical sarcomatous growth. Because of the coloration of the tumor, special stains were used in further study of the section and its relation to the xanthomatous group was completely ruled out; and I believe the final judgment can be left to Doctor Ewing's discussion: *"I should think that the*

FIG. 2.—Shows tumor definitely outlined, which was removed from knee-joint.

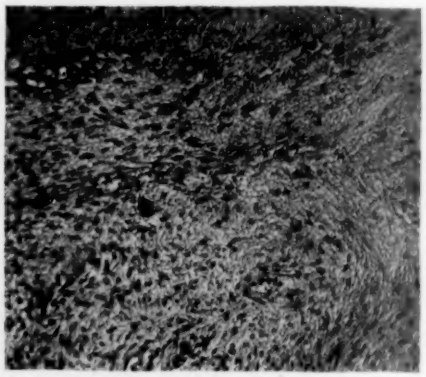

FIG. 3.—Photo-micrograph of tumor of knee-joint showing peculiar elongated blunt cells lying closely together; occasional mitotic figures are found.

diagnosis of fibro-endothelioma was correct. In the last microscopical picture shown there were groups of isolated cells, which would hardly be consistent with a fibroma and which have a somewhat polyhedral form. I would not venture to make a diagnosis on the lantern slides alone, if I had not seen in the past three months three cases very similar to these; one from Doctor Bloodgood, one from Doctor Smith, of Harvard, and another of our own. They show a variety of structures, but, in a general way, the picture approaches the cases which Doctor Wagner has just presented. The position of the tumor is strongly suggestive of an origin from the endothelial cells lining the bursa. There is no doubt that the bursal endothelioma is capable of extensive proliferation producing tumors of this same general character."

Clinical classification.—This type of tumor is certainly most rare. It has no particular selection for any particular age or sex, therefore occupations would have no bearing or predisposition as to such tumors. It has been noticed but on two occasions in the study of 467 explorations of major

joints of the body, extending from the year 1900 to 1930, as taken from the private files of the late Dr. Virgil P. Gibney and myself.

The symptoms are marked by the ever-presence of pain, which is of a dull, aching character, and the patients walk with a limp. They cannot seem to find a comfortable attitude for the affected joint. The cases are first diagnosed as a chronic synovitis, as they so much resemble this condition.

Diagnosis.—These cases are very difficult to diagnose, especially when the tumors are small. There is swelling in only one part of the affected joint. There is no particular tenderness nor increase of synovial fluid. The range of motion is very rarely affected, because there is no change in the articular or periarticular structures. The diagnosis is further augmented by the *careful study of the X-rays with special attention to soft tissue structures* (see Figs. 1 and 4).

Treatment.—The treatment is surgical and, although a complete enucleation may be secured, they are prone to recur. X-ray treatment or Coley's toxin may be tried, but so far no cures are reported. The tumors are removed as often as they recur and usually end with amputation of the affected extremity, which brings about the final cure.

CASE I.—An adult, thirty-five years old, a musician, with an irrelevant family and past history, without any apparent cause began to complain about ten years ago of pain in the right knee. It was treated with the usual rheumatic treatment by the family physician but with no improvement. In the summer of 1923 he consulted a surgeon and the limb was immobilized in plaster without any relief of symptoms. The patient came under the care of Doctor Gibney and myself in October, 1923. Examination showed him to be in good condition but he was walking with a slight limp, although the functions of the right knee were not impaired. There was a one-inch difference in the measurement of the knees, with a slight fullness under the right patella tendon, which was slightly tender. He brought a report of X-ray findings, which were normal, although I did not see the pictures. The case was thought to be one of chronic synovitis, especially of the retro-patella sac, and was treated conservatively with cautery and strapping. He did not improve but, rather, the pain became worse and extremely so in wet weather, so that it required codeine for relief. In January, 1924, an X-ray (Fig. 1) was taken, which showed a mass behind the patella tendon that was thought to be hypertrophied synovial tissue, but a definite tumor was not considered. On looking back it can easily be recognized. On February 13, 1924, the patella was split and the knee-joint exposed. A solid tumor covered by a synovial veil lay in the knee-joint. It was attached to the outer antero-inferior border of the capsule by a small attachment. The tumor (Fig. 1) was so large that it was divided longitudinally to facilitate removal and shelled out with little difficulty. The knee-joint was normal otherwise. The tumor (Fig. 2) measured 7 by 5 by 3 centimetres, was elliptical in shape, and surrounded by a definite capsule. It was hard, and a diagnosis of benign fibroma was made from the gross examination. Under the microscope the tumor shows peculiar, elongated blunt cells lying close together. Mitotic figures, although few, were seen. It was thought to be a very atypical fibro-sarcoma but I believe it is a fibro-endothelioma arising from synovial tissue. The patient was free from pain for one year when the tumor reappeared on the lateral surface of the knee. An extensive resection was done of the capsule of the joint and the patient was again free from symptoms after the second operation. He received extensive X-ray therapy by Dr. Francis Carter Wood and a thorough course of Coley's toxin. In 1926 the symptoms and signs reappeared. The

tumor had invaded the upper end of the tibia, under the patella tendon. Resection was unsatisfactory at the third operation and two weeks later a mid-thigh amputation was done. Examination, March, 1930, showed patient well and free from recurrences or metastases. No further treatment.

CASE II.—A girl, fifteen years old, has complained of a swelling and pain on the anterior surface of the right ankle-joint for about six years. She has been treated by various clinics for synovitis. Examination is negative except for the right ankle-joint. The anterior surface of the ankle-joint shows a semi-solid, movable tumor right under the tendons on the dorsum of the ankle. X-rays (Fig. 4) show a definite soft tissue mass anterior to the ankle-joint. An arthrotomy was performed February, 1929, and a tumor measuring 6 by 3 by 2 centimetres was removed. It was attached to the synovial membrane of the ankle-joint. It was kidney-shaped and brown and yellow-tinged, smooth and definitely encapsulated. To the touch it was solid as in kidney tissue and therefore very cellular in substance. Microscopically it was composed of peculiar, elongated, blunt cells lying close together. No mitotic figures were seen. It is thought to be

FIG. 5.—Photograph of cross-section of tumor of ankle-joint showing the increased pigment towards the center of tumor and compactness of the tissue elements.

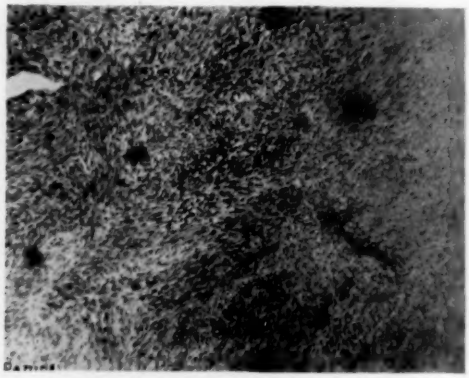

FIG. 6.—Photo-micrograph of tissue from tumor of ankle showing groups of cells which are identical with Fig. 3 and hyaline degeneration is also represented.

synonymous with a fibro-endothelioma arising from synovial tissue. It is difficult to give a prognosis as Case I ended in amputation of the leg because of the recurrence in the knee-joint. Examination in March, 1930, showed no recurrence so far to this date, although the patient is beginning to complain of a little pain which usually precedes the appearance of the tumor.

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MULTIPLE MYELOMA AS A SINGLE LESION

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In a recent publication in the *Archives of Surgery* for April, 1928,[1] on multiple myeloma, a complete review was given of the literature and thirteen case reports added from the Surgical Pathological Laboratory of the Johns Hopkins Hospital. In this paper an analysis was made of the symptoms and findings in all the cases which were available either in the literature or in this laboratory. For purposes of diagnosis attention was called to six cardinal features of the disease which were usually found present collectively or in pairs or triads in any individual case. These six cardinal diagnostic features of multiple myeloma were (1) multiple involvement of the skeletal trunk by tumor formation in an adult over thirty-five years; (2) pathological fracture of a rib; (3) the presence of Bence-Jones bodies in the urine; (4) lumbar backache with signs of early paraplegia; (5) an otherwise inexplicable anæmia; (6) a chronic nephritis with nitrogen retention and low blood-pressure.

The case to be reported here is presented, not from the angle of adding another case to the literature, but in order to call attention clinically to the exceptional case of multiple myeloma which breaks all the usual rules for the diagnosis of this disease. In this recent case, not one of the six diagnostic features listed above was present. The patient had but a single bone lesion. The ribs were uninvolved by the disease. The urine was negative for Bence-Jones bodies and there were no symptoms referable to the spine or to the central nervous system. The patient's hæmoglobin and red blood cell count were within normal limits and clinically he was without signs of nephritis. The case report follows:

The patient (C. S.—Path. No. 42108) was a white male, aged forty-five, and a hotel steward by occupation, who had always enjoyed good general health. He gave an essentially negative family and past history. The present illness began two months previously, when he first noticed pain in the upper third of the left thigh, on lifting a pile of heavy dishes. The pain, which lasted about one week, was severe, drawing in character and radiated down the left thigh. It caused him to limp, and this disturbance of function persisted. Two treatments were given by a chiropractor without benefit, and after two weeks a medical practitioner gave tablets and liquids without relief. One month before admission to the hospital because of continued pain, a surgeon was consulted, an X-ray was taken and operation was advised, although no diagnosis was rendered.

On examination of the patient, October 10, 1929, practically no positive findings were disclosed. The general physical examination was negative. There was no visible or palpable swelling over the painful area and practically no tenderness to pressure. There were no enlarged glands in the region. The only difference between the left thigh and the normal was the subjective pain and the noticeable limp on walking. The neurologi-

cal examination was negative. The prostate was normal to palpation, and no symptoms referable to the genito-urinary tract could be elicited. The blood examination showed Hæmoglobin 85 per cent.; red blood cells 4,930,000; white blood cells 13,000; with differential count, 81 per cent. polymorphs; 13 per cent. lymphocytes; 6 per cent. mononuclears and transitionals. The blood-pressure was 115/72 mm.

The urine examination was negative except for a trace of albumin and a rather high specific gravity. The examination for Bence-Jones bodies was negative.

The most significant findings were brought out by röntgenologic studies. The X-ray of the left femur (see Fig. 1) showed an area of medullary bone destruction in the upper shaft at the site of the nutrient artery extending from the intertrochanteric line to the beginning of the middle third of the femur. About this area the cortical bone was everywhere intact, without any signs of disturbance of the periosteum. The shadow of rarefaction faintly resembled a confluence of three separate areas, but this was not distinct enough to warrant an opinion that the lesion had begun in more than one

FIG. 1.—P. N., 42108. X-ray of the femur in multiple myeloma appearing clinically as a single lesion, in a white male aged forty-five. There were no symptoms except pain and limping of two months' duration. The X-ray shows a central area of bone destruction at the site of the nutrient artery with an intact shell of cortical bone. There is no periosteal reaction.

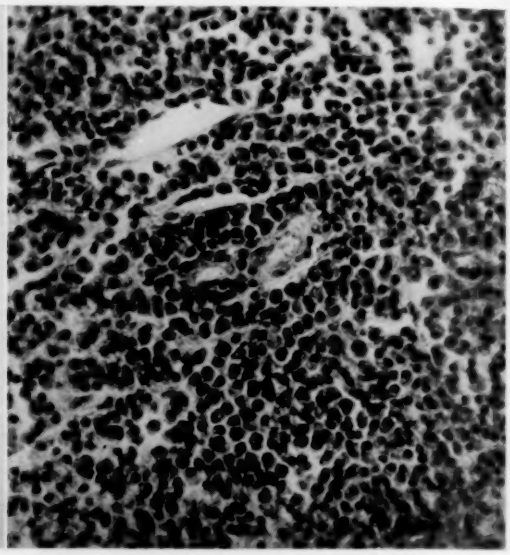


FIG. 2.—P. N., 42108. Photomicrograph of tissue removed at biopsy from the same case shown in Fig. 1. The high power shows cells with a clear cytoplasm and an eccentrically placed nucleus. The chromatin in the nuclei frequently has a spoke-like arrangement. The cells are unusually closely packed and the tissue is rich in young capillaries. This is the so-called plasma cell type of multiple myeloma.

focus. X-ray examination of the other long bones, the pelvis, and the spine was negative. There was no evidence of metastases in the lungs; the ribs were essentially normal. The skull was negative.

The clinical diagnosis rested between a metastatic carcinoma to bone (probably hypernephroma) or an unusual myxochondroma arising in the neighborhood of the lesser trochanter. The intact shell of cortical bone did not favor a myxochondroma at this site. The absence of involvement of the skeletal trunk, and the single area of bone involvement were against multiple myeloma. Exploration was advised and at the operation performed by Doctor Bloodgood, the affected area of bone was exposed showing an essentially normal periosteum and cortex. There was, however, unusual vascularity and much hæmorrhage was encountered in stripping the periosteum. On opening the bone shell a mass of semifluid, red and yellow tumor mixed with much blood poured from the wound. A uniformly red and spongy mass lined the cavity, resembling

in consistency a firm and partly organized blood clot. Continual packing was necessary to check hæmorrhage which did not cease until the tumor lining had been stripped from the cavity. The cavity was cauterized with the electric cautery, and sponged with gauze wet in 50 per cent. zinc chloride. The cavity was packed with iodoform gauze and the wound closed with silver wire. A Thomas splint was applied to avoid fracture.

Frozen sections made at the time of operation showed a tumor composed of an uniform sheet of cells resembling the plasma cell. A microscopic diagnosis of multiple myeloma of the plasma-cell type was made and confirmed later by permanent sections (see Fig. 2).

Pathologic fracture occurred shortly after the operation through the affected area which healed under proper treatment. The patient returned home four months after the operation and had a second pathologic fracture in March, 1930. Repeated examinations of the urine for Bence-Jones bodies made during the patient's stay in the hospital were negative. The patient is gradually losing ground despite deep X-ray therapy and Coley's toxins.

This case is remarkable for the brief duration and simplicity of the symptoms and physical findings. Pain and limping for two months, referable to the left thigh, were the only positive findings in the history. In addition the X-ray showed but a single bone lesion. Other than the microscopic section, the only evidence in favor of a diagnosis of multiple myeloma was the distinct medullary origin of the tumor in a portion of the skeleton where red bone marrow is present, the age of the patient, which was over thirty-five, and the extreme vascularity of the tumor at exploration. Although it is too recent at this time to determine whether or not the other bones of the skeleton will show clinical involvement, it is safe to presume that the disease will progress and disseminate despite the treatment administered. There is on record another case similar to this one which supports this statement. This is a case which came under the observation of Dr. George Crile and which was seen in consultation by Doctor Bloodgood and diagnosed multiple myeloma microscopically by Welch, Bloodgood and MacCallum. The case has been referred to by Bloodgood in "Progressive Medicine" for 1906,[2] and is abstracted as Case 11 in the author's contribution referred to above.

This second case of Doctors Crile and Bloodgood (P.N. 7232) was a white man aged thirty-seven, with a history of pain, following a trauma fourteen months previously. Tenderness and swelling were present in the right clavicle and the X-ray showed a lesion in the outer third of this bone which produced a rarefied area accompanied by expansion of the bone shell. Nothing could be seen in any other bone, and there was no anæmia. The urine was not examined for Bence-Jones bodies prior to operation, but when a biopsy was made and multiple myeloma reported from the frozen section, the patient was catheterized and Bence-Jones bodies were readily demonstrated in the urine. The complete clinical follow-up of this case is on record. The ribs were subsequently involved; there was evidence of extension of the disease to the skull and the patient died six months after the operation.

These two cases substantiate the claim for consideration of multiple myeloma in the differential diagnosis of single bone lesions, when these lesions occur in an adult over thirty-five and are distinctively medullary and bone destructive in character. It is important to bear in mind however, that the site of the lesion is always confined to the red marrow bones.

The usual solitary bone tumor producing a distinctly central area of rarefaction in a long bone in an adult is either a giant-cell tumor in an epiphysis or a metastatic carcinoma in the shaft of the bone near the site of the nutrient artery. There should be no difficulty in distinguishing between multiple myeloma and a giant-cell tumor. Multiple myeloma practically never occurs primarily in an epiphysis which is the favorite site of the giant-cell tumor.[3] More accurately, the location of the giant-cell tumor is

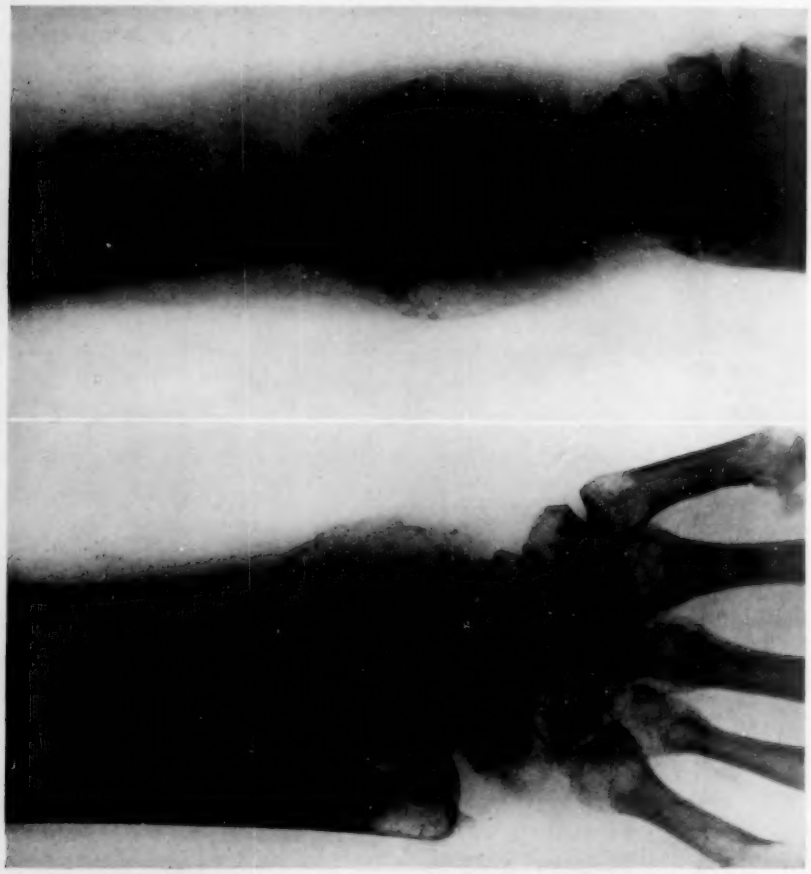
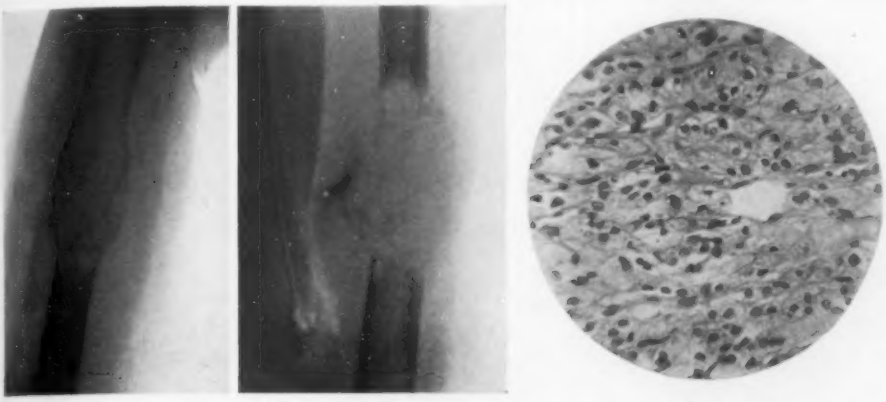


FIG. 3.—P. N., 37708. X-ray picture of a typical giant-cell tumor in the lower end of the radius, occurring in a white female aged thirty-one. There had been a trauma one year previously, followed by pain. The lesion is too far advanced to show the typical asymmetry but it occupies the epiphysis where it has nearly completely destroyed the bone shell. This lesion recurred after curetting, but was cured by resection and has remained well over two years.

subcortical and the healing reaction in the bone shell permits an asymmetrical expansion. In addition the three most frequent locations for the giant-cell tumor—the upper end of the tibia, the lower end of the femur and the lower end of the radius—are not at the site where red bone marrow is found (Fig. 3).

There is no way to diagnose clinically between multiple myeloma as a single lesion and a metastatic carcinoma of the bone (Fig. 4). Both are

primarily central bone destructive lesions. Bence-Jones bodies in the urine of multiple myeloma patients occur more frequently (approximately 65 per



A B C

FIG. 4.—P. N., 29461. A, B and C: Two X-ray pictures and a microphotograph of a central bone destructive lesion in the shaft of the humerus, in a white female aged fifty-five. In A the shell of cortical bone is still intact with a moderate amount of expansion. In B the X-ray taken two months later shows disappearance of the bone-shell with increased size of the tumor. Microscopic examination of the specimen removed by amputation showed a hypernephroma. The unusual feature in this case was the finding of Bence Jones bodies in the urine. This is the only case on record of a hypernephroma, showing Bence Jones bodies. The patient died eight months after operation. C shows the typical microscopic structure of the hypernephroma.

cent.) than in patients with metastatic bone lesions, but these bodies may be absent in multiple myeloma or rarely present in cases of metastatic car-

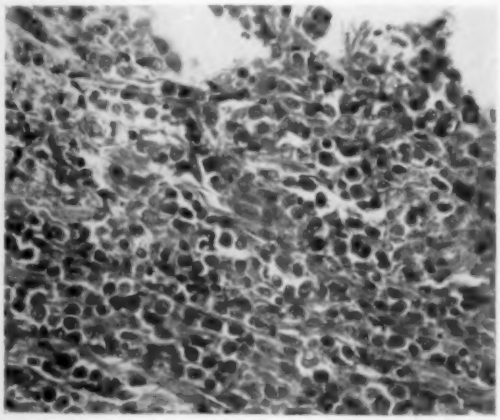


FIG. 5.—P. N., 30441. High-powered microphotograph of tissue taken from a patient with chloroma. The cells shown are of the myelocytic variety with less cytoplasm than the typical myeloma cell. There is less chromatin in these nuclei and a more definite nucleolus. The cells however have the same general arrangement as myeloma. The patient was a white male adult with bone lesions in the femur, humerus and pelvis. The white blood cell count showed a typical myelogenous leukemia. The disease pursued a rapidly fatal course.

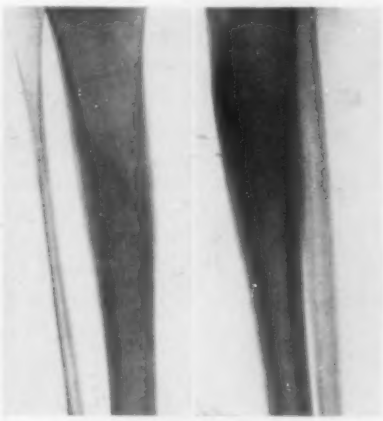


FIG. 6.—P. N., 29286. X-ray picture of the tibia of a white female age twelve, with a painful tumor of seventeen months' duration. This is the typical röntgenologic appearance of a Ewing's sarcoma. There is expansion of the shaft of the bone produced by thickening of the cortex which is reacting to tumor evasion. The periosteum is raised in parallel layers, giving the so-called onion layer appearance. This patient is alive six and one-half years after amputation.

cinoma in the skeleton. These rare cases of Bence-Jones bodies in the urine of cases other than multiple myeloma have been tabulated in a previous

article.[1] Clinically the metastatic tumors to bone are more usually single lesions, and, in addition to the discovery of the primary site of the carcinoma, most often in the breast, the prostate, the thyroid or the kidney, this fact aids in making a diagnosis. Metastatic carcinoma is less frequent in the ribs or clavicle than multiple myeloma, and terminates more often with pulmonary involvement.

Very rarely a single bone destructive tumor arising near the orbit will simulate multiple myeloma under the microscope (Fig. 5). These tumors, when freshly incised, have a greenish hue and the blood count of the patient usually shows a definite leucemia. The tumor is known as a chloroma. The most important point in the differential diagnosis in such a case is the

FIG. 7.—P. N., 31419. X-ray of the lower tibia of a white male age fifty, showing a tumor of twenty-five years' duration. The X-ray shows an area of central bone destruction in the marrow cavity of the metaphysis, extending partially into the epiphysis. The lesion is well circumscribed and there is a thick shell of cortical bone. This is a typical latent bone cyst which healed and completely ossified three and one-half years after curetting.

FIG. 8.—P. N., 33423. X-ray of a myxo-cartilaginous tumor in the upper femur of a white male age forty-nine. There had been a trauma two years previously and pain of one year's duration. The X-ray shows an area of bone destruction with a perforated bone shell at the site of the greater trochanter. The lesion recurred after many curettings and cauterizations (over 15). The patient despite amputation finally died six years after the onset of the disease.

white blood cell count. The clinical picture of these very rare cases of chloroma has been ably described in an article by B. Brannan in the Johns Hopkins Bulletin.[4] These skeletal lesions associated with a leucemia are frequently multiple and may have the same distribution as multiple myeloma.

Ewing's endothelial myeloma which occurs in younger patients and is extremely rare after thiry-five years of age, has been frequently described in the literature as a medullary and bone destructive tumor. Studies made in this laboratory[5] do not confirm this contention and point to the fact that the Ewing tumor is generally intracortical or subperiosteal in origin and

is usually bone destructive in only the later stages. The typical X-ray picture of a Ewing's sarcoma (Fig. 6) shows the bone of a patient between fifteen and twenty years of age in which the shaft of a long bone has been

FIG. 9.—P. N., 29639. Typical X-ray picture of multiple myeloma showing multiple punched out areas in the bones. The patient was a white female aged seventy-two, with symptoms of two years' duration. The complete röntgen examination showed over 56 punched out circular areas of various sizes, scattered through the spine, the sacrum, the skull and the long pipe bone. The microscopic examination showed a typical plasma cell myeloma similar to Figure 2. The urine was positive for Bence Jones bodies. The patient died shortly after coming under observation.

symmetrically widened by new bone formation laid down by the reacting cortex. The reacting cortex frequently encroaches upon the marrow cavity and often the bulk of the tumor is found beneath the periosteum above the

cortex. This X-ray picture with its actively reacting cortical bone (the new bone is not of tumor origin) is in sharp contrast to the multiple myeloma which gradually destroys the cortex from within, without producing new bone formation. The occurrence of Bence-Jones bodies in the urine of a patient with a Ewing's tumor has never been recorded to my knowledge.

Occasionally a latent bone cyst walled off in the medullary cavity of a long bone in an adult will simulate the unusual picture of multiple myeloma described here (Fig. 7). However, the shell of bone about the latent bone cyst usually has a thick and competent defensive appearance, whereas in the X-ray of multiple myeloma there is progressive thinning of the cortical bone until fracture occurs. The typical bone cyst occurs in much younger patients between the ages of ten and twenty years, and the bone sites are usually in the metaphyseal regions in those bones most frequently affected by giant-cell tumor. The difference in this distribution is that the bone cyst is rarer in the lower radius and more frequent in the upper humerus than the giant-cell tumor.

In rare instances a myxochondroma, either predominantly a chondroma or a myxoma, will resemble the unusual case of multiple myeloma. These myxochondromas, however, have their origin near the tuberosity of some bone and, if not actually a periosteal lesion, are usually asymmetrically situated on the side of the tuberosity (Fig. 8). They are more apt to have a trabeculated structure in the X-ray and to produce a palpable swelling clinically. They occur in the same age groups as multiple myeloma does, but the duration of symptoms in these fibrocartilaginous tumors is longer. From a histogenetic point of view the chondromas and myxomas are not to be considered primarily central tumors of the long pipe bones. However, they do form central tumors in the small bones of the hands and feet, which is their most frequent location.

When multiple myeloma is present in the typical form with involvement of the skull and bones of the trunk, the differential diagnosis is much simplified. The disease in its early stages is characterized by rheumatic pains about the chest or in the lumbar region. Pathologic fracture frequently occurs (62 per cent.) and the bone most often thus affected is a rib. Multiple bone involvement visible in the X-ray as circumscribed, central, punched-out areas is the rule. Palpable yielding tumors which may pulsate or crepitate are found in the ribs, the spine, the skull, the pelvis or in the extremities about the pelvic and shoulder girdles. Deformity in the spine with shortening of stature and signs of paraplegia occur. Anæmia of a relatively severe grade and Bence-Jones bodies in the urine are typical laboratory findings. Chronic nephritis is present in 70 per cent. of the cases and a progressive downward course with a fatal termination is the invariable outcome (see Fig. 9 and Fig. 10).

In conclusion, it is important to record here that a primary bone destructive lesion occurring centrally in a single bone, in the shaft of an adult, without expansion of the bone shell, should always excite the suspicion of

malignancy. Rarely the lesion may be a latent bone cyst, most frequently it is a metastatic carcinoma, but occasionally it is a multiple myeloma. The entire skeleton and the lungs should be X-rayed, for in this way the multiple myeloma or metastatic bone tumor, which are both hopeless diseases, may be disclosed, and an unnecessary operation avoided. The urine must not fail to be examined for Bence-Jones bodies.

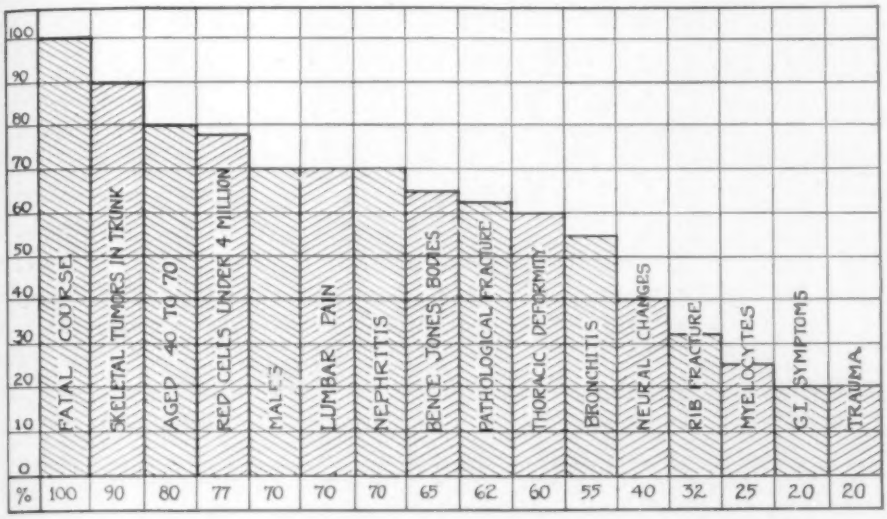


FIG. 10.—Chart showing the incidence by percentage of the leading symtoms of multiple myeloma. Reproduced from the Archives of Surgery, vol. xvi, p. 846, 1928.

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MALIGNANT TUMORS AND THEIR METASTASES

A SUMMARY OF THE NECROPSIES ON EIGHT HUNDRED SIXTY-FIVE CASES PERFORMED AT THE BELLEVUE HOSPITAL OF NEW YORK

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This brief review of a series of malignant tumors was collected from the autopsy protocols of Bellevue Hospital, New York City, and covers a period of twenty-three years. During that time, 13,500 autopsies had been performed, and out of that number 865 were done on malignant tumors, approximately 6 per cent. Of these tumors, 770 were of epithelial origin, while ninety-five arose from connective tissue, a ratio of eight to one.

The object of this paper is to emphasize the end-results in malignant tumors, as seen at necropsy, particularly their anatomical distribution and the distribution of their metastases. For purposes of description, metastases in this series have been divided into three groups: (1) local, in which the neoplasm confined itself to the organ in which it arose or metastasized, only to immediately adjacent structures or lymph-nodes; (2) multiple local, in which the growth invaded, probably by direct extension, the neighboring organs and structures; (3) diffuse, in which the tumor not only invaded the neighboring tissues, but, in addition, metastasized to some remotely placed organ or structure.

Tongue.—Nine cases, all males, average age fifty-one years, youngest forty-one, oldest sixty-one. The majority of these tumors involved the regional lymph-nodes, while only about 30 per cent. invaded distant structures, as the lung, heart, liver and brain.

Œsophagus.—Of the eighty-three cases, all but two occurred in males—eighty-one males, two females. This interesting sex ratio checks up very closely with the surgical records of the first division, for out of forty cases from which tissue was taken for biopsy, all but one occurred in males. Carcinoma of this structure seems to be associated with the latter decades of life, as the average was sixty-one years, and in only twenty-three cases did it occur below fifty. In the majority of cases this neoplasm showed a marked tendency to remain local, invading usually the immediately adjacent structures, as the lymph-nodes, lungs and liver. Occasionally, regardless of age of patient, or morphology of tumor, these tumors widely disseminate themselves throughout the body, but this is the exception and not the rule. The fact that the majority of these tumors are of local growth may be due to the fact that ulceration and obstruction probably occur early in their course,

and the resultant infection and starvation terminate the case before distant metastases have time to form.

Stomach.—Number of cases, 208. Of this number 155 occurred in males and fifty-three in females, a ratio of three to one. The average age was fifty-six years, with an extreme variation of twenty-eight to ninety years. The pyloric end was involved in 80 per cent. of the cases, the cardia in 10 per cent., and the lesser and greater curvature in 10 per cent. When the cardia is involved the growth usually extends into the œsophagus, thus making it difficult to determine whether the growth arose primarily in the stomach or œsophagus. In this series there were but four cases of linitis plastica. It is of particular interest to note that thirty-two cases, or 15 per cent., showed no obvious evidence of metastases. The usual site of metastases is the lymph-nodes and liver, the latter organ being involved in 45 per cent. of the cases, and the lymph-nodes in 44 per cent. The lymph-nodes most usually invaded are, first, the suprapancreatic and retroperitoneal and, secondly, the gastric. The lungs were involved in only 6 per cent. of the cases. It may be said in general, that carcinoma of the stomach is either distinctly local or multiple local in growth.

Small Intestine.—Number of cases, three—males two, females one. The average age was fifty-five, the youngest being forty-one and the oldest seventy years. Two of these cases arose in the duodenum and one in the jejunum. The metastases were distinctly local in character, involving the immediately adjacent organs and lymph-nodes.

Large Intestine.—Number of cases, sixty-one. The average age is about the same as that for the stomach, namely, fifty-five years, with extreme variation of twenty to eighty-four years. Although the average age of fifty-five was about the same as that of the stomach, 33 per cent. of the cases occurred below fifty—a very much lower age average than that for carcinoma of the stomach. The sexes were more equally divided, being thirty-six males to twenty-five females, a striking difference to that of the stomach, in which the proportion was three males to one female. In the large intestine, the site most frequently involved was the sigmoid; next, the cæcum, then the descending colon with splenic flexure of the colon fourth. The transverse and ascending colon, excepting at the hepatic and splenic flexures, were seldom affected. Metastases usually were local in their distribution, involving the neighboring nodes and adjacent tissues. The liver, pancreas and spleen were seldom invaded, excepting where the primary growth originated in the near vicinity of these organs. Remote metastases to the pleural cavity were exceedingly uncommon, while the number of cases showing no obvious metastases was a strikingly common occurrence. It is of considerable interest to note that 25 per cent. of these autopsies showed that the primary cause of death was due to perforation and peritonitis. Metastases: local, forty-eight, multiple local, seven, diffuse, six.

Rectum.—Number of cases, twenty-six—average age, fifty-six years; limits seventy-five to forty-four years. Sex: males, twenty-one, females,

five. In this site, carcinoma generally appears to be a far more widely metastasizing tumor than it is in any other position in the whole alimentary tract. It involves, in general, the neighboring nodes and adjacent tissues, the liver in 50 per cent. of the cases, and, not infrequently, other abdominal organs and the lungs. Metastases: local, eight, multiple local, four, diffuse, fourteen.

Pharynx, Larynx and Trachea.—Number of cases, seven—average age, about fifty-two years; sex, all males. Metastases usually very local in their distribution, infiltrating the surrounding tissues and invading the neighboring nodes. Occasionally, these tumors invaded the lung and even the heart, but this seemed to be a rare occurrence. Ulceration with its subsequent infection seemed to be the most obvious cause of death. Metastases: local, five, multiple local, two.

Lungs.—Number of cases, thirty-seven—average age, forty-nine, limits twenty-four to seventy-three years; sex, thirty-four males, three females. Three-quarters of these tumors were carcinomatous or adenocarcinomatous in type and arose probably in the bronchi. The remaining quarter were not gland-cell tumors, being more of the epitheliomatous or squamous type. The adenomatous tumors usually metastasized widely throughout the thoracic cavity, and in most cases involved many of the abdominal organs. The squamous-cell type of tumor was usually local in its growth, only one case metastasized distally to the kidney. Metastases: local, eight, multiple local, twenty-two, diffuse, seven.

Breast.—Number of cases, fifty-one—average age, fifty-five, with extreme variations of twenty-one to eighty years; sex, one male, fifty females. This neoplasm in the latter stages of its course metastasizes extensively, locally and distantly. One of the interesting findings in this series was the more frequent involvement of the liver than the lungs, the former occurred in 34 per cent. of cases, while the latter in only 20 per cent. Bones, usually the ribs, were invaded in 22 per cent. of the cases; the involved ribs were probably local extensions. Occasionally these tumors widely disseminate themselves throughout the body, invading diffusely many organs and structures. Metastases: local, six, multiple local, thirty-three, diffuse, twelve.

Ovary.—Number of cases, six—average age sixty years, limits forty-three and seventy years. Metastases usually diffuse involving the surrounding structures, the retroperitoneal nodes, the liver and lungs. Metastases: local, one, diffuse, five.

Cervix and Uterus.—Number of cases, twenty-two, of which sixteen occurred in the cervix and six in the body of the uterus. The average age was forty-five years, with limits of twenty-eight and sixty years. About 50 per cent. of cases occurred in women under forty-five. Metastases both cervix and uterus were usually local or multiple local, invading presumably by direct extension the bladder, surrounding tissues and regional lymph-nodes. Only four cases involved distant organs, one of which arose in the cervix and three in the uterus. The one arising from the cervix metastasized

to the lungs, while of the three arising from the uterus, one metastasized to the pancreas, one to the pleura, lungs, liver and sacral vertebræ and one to the lungs. Metastases: local, thirteen, multiple local, five, diffuse, four.

PROSTATE.—Number of cases, forty—average age, between fifty-five and sixty years, with extreme variations of twenty-four to eighty years. About one-half the cases occurred in men of sixty years or over. These tumors usually showed extensive local involvement of bladder and regional nodes. The vertebræ was affected in about one-third of the cases, while extensive involvement of peritoneal and pleural cavities were the rule rather than the exception. Metastases: local, thirteen, multiple local, fourteen, diffuse, thirteen.

TESTICLE.—Number of cases, three. The number of cases in this series was so few that the age incident is of little, if any value. Average age was forty-four years, with thirty-eight years the youngest and fifty-five years the oldest. The metastases were mostly distant, involving extensively the lung, liver, the pleural and peritoneal cavities and occasionally the vertebræ. Metastases: diffuse, three.

URINARY BLADDER.—Number of cases, twenty-nine—average age, about fifty years, the youngest being thirty-eight, the oldest seventy-four years. Sex, twenty-seven males, and two females. This neoplasm in its growth shows a marked tendency to remain local, as over one-half the cases showed either no obvious evidence of metastases or else invaded only the immediately adjacent tissues. In less than one-half the cases the retroperitoneal nodes were involved, and distant metastases to lung, liver and bone were noted in but three cases. Metastases: local, sixteen, multiple local, ten, diffuse, three.

KIDNEY.—Number of cases, ten—average age fifty-five years, limits twenty-five to eighty. Sex, eight males, one female. Metastases almost invariably widespread, involving diffusely the abdominal and thoracic organs and lymph-nodes. The two cases of no metastases noted in the chart were probably adenomas. Metastases: local, three, diffuse, seven.

HYPERNEPHROMA.—Number of cases, thirty-two—average age, fifty-four, with the youngest eighteen, and the oldest seventy-one years. Sex, twenty-two males, five females. It is of interest to note that the average age for females was thirty-six years, while the average for males was fifty-five years. As a general rule, this is perhaps one of the most diffusely and profusely metastasizing tumors that we see, as it involves in most of the cases either the thorax or abdominal cavities or both, and in 20 per cent. of the cases bone. Metastases: local, four, multiple local, two, diffuse, twenty-six.

LIVER.—Number of cases, thirty-nine—average age, forty-six, limits eighty-five to twenty-four years. In a little less than half of the cases the age was forty-five years. Sex, thirty males, nine females. The growth in most cases seemed to be localized to the liver, but in 35 per cent., the tumor was a widely metastasizing one, extensively involving the lymph-nodes, peritoneum, many organs of the abdominal cavity, and rather infrequently the

lungs and pleura. Metastases: local, twenty-two, multiple local, three, diffuse, fourteen.

GALL-BLADDER AND BILE-DUCTS.—Number of cases, thirty-two. The average age incident is similar to that of the liver. The sex ratio was twenty-one males to eleven females. These tumors in about one-half the cases invaded the liver, evidently by direct extension. In other respects it metastasizes as does the primary carcinoma of the liver; that is, about twenty-one local and seven diffuse.

PANCREAS.—Number of cases, thirty-four—average age, fifty-six, limits seventy-five to thirty-three years. In only nine cases out of thirty-four did it occur at ages under fifty. Sex, twenty-seven males, seven females. Metastases in the majority (60 per cent.) of cases invaded the liver and usually disseminated itself widely throughout the abdominal cavity, but only infrequently involved the lung (four times). Metastases: local, thirteen, multiple local, three, diffuse, eighteen.

THYROID.—Number of cases, five—average age, forty-four years, limits thirty-five to sixty years. Sex, three males, 2 females. One of these tumors was of local growth, four extensively involved the liver and lungs and supraclavicular nodes. Metastases: local, one, diffuse, three.

PAROTID.—Number of cases, three—average age, fifty-two years; all occurred in males. The two that metastasized were remarkable, in that their metastases were widely distributed throughout the body, involving almost all the organs and structures of the thoracic cavity, the liver in one case and the adrenals and kidneys in both. The one case that did not metastasize was evidently the local growing, non-metastasizing type of mixed tumor. Metastases: local, one, diffuse, two.

BRANCHIOGENIC.—Number of cases, three—average age, fifty-five, with the youngest forty-four and the oldest seventy years. Sex, two males, one female. In one of the cases the neoplasm remained of local growth, involving extensively the tissues of the neck. The remaining two cases involved not only the structures of the neck, but metastasized distantly to the liver. Metastases: local, one, diffuse, two.

THYMUS.—Number of cases, one—age five; sex, male. In this case the tumor metastasized to the neighboring nodes, lung and pleura. Metastases: diffuse, one.

SKIN.—Number of cases, seven, limits twenty-nine to sixty years, average age about fifty years. Sex, all males. Two of these cases arose from the skin of the neck, one on chest and one on leg, face, scrotum and penis. All of these tumors excepting two invaded the neighboring nodes alone. Of the two exceptions, one arose from the skin of the chest and metastasized to the lungs, the other arose in the neck and metastasized to the liver. Metastases: local, five, diffuse, two.

MELANOCARCINOMA.—Number of cases, nine—average age, forty years. Sex, all males. Two of these cases arose in the small intestine, two in the eye, four in the skin of the toe, leg and scapula. The origin of the other was

unknown. The outstanding characteristics of this tumor are its frequent widespread metastases. Few of the malignant tumors possess this power of growth; certainly there are none that exceed it. It is of interest to note that, regardless of its site of origin, the liver is frequently involved, while the lymph-glands, though usually invaded, sometimes seemed to be entirely free. Metastases: diffuse, nine.

Pituitary.—Number of cases, one—age thirty-nine, sex, male. This neoplasm invaded locally the tissues, but did not metastasize.

Tooth Bud (Adamantinoma).—Number of cases, one—age fifty-five; sex, male. This tumor extensively invaded the tissues locally and involved the neighboring lymph-nodes.

Carcinoma of Unknown Origin.—Number of cases, twenty—average age, fifty-two years, limits thirty to seventy years. Sex, nine males, eleven females. Because of the diffuse nature of their growths, their site of origin was unknown. It is extraordinary the power of growth some of these tumors possess. One cannot help but be astounded by the remarkable powers of the living organism to withstand this onslaught for so long a time. Metastases: diffuse, twenty.

SARCOMATA

Sarcomata, unlike carcinomata, show no definite evidences in many cases of their site of origin, and are usually so diffusely distributed that their primary foci cannot with any degree of accuracy be determined. This is particularly true of lympho-sarcoma. Even in this series, some of these tumors seem to have involved, either primarily or secondarily, most organs and structures of the body. For this reason, it would seem advisable to present them in roughly classified groups, rather than to attempt a detailed description.

The average age was forty-five years, limits from three to seventy-four years. Twenty-five per cent. of the cases occurred at thirty-five or under. Sex, sixty-six males, twenty-nine females. Nearly half the cases (thirty-nine) were classified under the diagnosis of lympho-sarcoma. The average age for this group was forty-two years, with an extreme variation of from three to seventy-four years. Sex, twenty-eight males, eleven females. About two-thirds of the cases involved the lymph-glands, usually the retroperitoneal, seldom the cervical. In many cases, the lymph-glands were diffusely involved, while other organs and structures of the body were relatively free. The lungs and mediastinal nodes were seldom the primary site. The stomach was involved in but one case, the intestinal canal in seven, the liver in three and the thymus in six. The retroperitoneal region was diffusely invaded in nine cases. Metastases were usually very diffuse, tumors arising probably in the thymic and cervical region practically always invaded the mediastinum and not infrequently the retroperitoneal nodes, but, strangely enough, the lungs were often free. Tumors arising in the retroperitoneal region or retroperitoneal nodes, or in other structures in the abdominal cavity usually

TABLE I

Malignant Epithelial Tumors

Primary Site	Number	No. Metastases	Nodes	Liver	Lung	Pleura	Pericardium and Heart	Spleen	Omentum	Mesentery	Peritoneum	Pancreas	Stomach	Small and Large Intestine	Uterus	Ovary	Adrenal	Kidney	Brain	Thyroid	Bone	Diaphragm	Skin	Thymus	Bladder	Trachea	Local	Multiple Local	Diffuse
1. Tongue	9	1	7	2	2	3	3	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	5	1	3
2. Œsophagus	83	29	34	19	14	0	1	1	0	0	2	2	4	1	0	0	1	4	2	3	2	1	0	0	0	0	49	25	9
3. Stomach	208	32	95	98	14	13	4	10	23	11	26	24	0	10	0	2	6	11	0	0	7	3	0	0	0	0	78	89	41
4. Small Intestine	3	0	2	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0
5. Large Intestine	61	36	16	14	0	1	1	1	0	1	3	2	0	0	0	0	2	1	0	0	0	1	0	0	0	0	48	7	6
6. Rectum	26	5	12	13	3	2	0	2	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	8	4	14
7. Pharynx and Larynx	7	4	3	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0
8. Lungs	37	4	10	6	2	4	0	1	0	0	0	0	0	1	0	0	2	3	3	0	6	0	0	0	0	0	8	12	7
9. Breast	51	5	21	17	10	8	0	4	0	1	3	2	1	1	2	0	5	2	2	0	12	0	1	0	0	0	6	13	12
10. Ovary	6	0	3	4	2	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5
11. Cervix	16	8	8	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	10	3	1
12. Uterus	6	1	4	1	2	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	2	3
13. Prostate	40	3	24	9	15	6	0	3	0	0	0	2	1	4	0	0	3	3	0	0	14	1	0	0	12	0	13	0	13
14. Testicle	3	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
15. Bladder	29	17	11	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	16	10	3
16. Kidney	10	2	4	2	3	2	4	3	0	0	0	0	0	0	0	0	3	0	0	0	4	1	1	1	0	0	3	0	7
17. Hypernephroma	32	4	13	14	18	3	3	0	0	1	0	1	0	0	0	0	2	1	4	2	6	0	4	0	0	0	4	2	26
18. Liver	39	19	5	0	6	2	1	1	1	0	0	2	1	0	0	1	4	4	0	0	2	2	0	0	0	0	22	3	14
19. Gall-bladder and Ducts	32	6	15	15	5	2	2	2	1	0	2	4	0	3	0	0	2	2	0	0	1	0	0	0	0	0	20	2	10
20. Pancreas	34	6	9	21	4	1	0	2	10	11	1	0	1	2	0	0	0	4	0	0	2	0	0	0	0	1	13	3	18
21. Thyroid	5	1	3	2	2	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	3
22. Parotid	3	1	2	2	1	0	1	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	2
23. Branchiogenic	3	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
24. Thymus	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
25. Skin	7	1	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5	0	2
26. Melanoma	9	0	7	7	4	0	0	0	0	0	0	0	0	0	0	0	2	0	6	0	0	0	0	0	0	0	0	0	9
27. Pituitary	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
28. Tooth Bud	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
29. Unknown	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
Totals	770	187	314	254	115	48	21	30	37	28	43	43	8	22	2	3	36	38	18	5	56	9	8	1	13	1	320	216	234
Sarcoma	95																												
Grand Total	865																												

involved diffusely the lymph-glands and surrounding tissues, and not infrequently the liver and spleen. The mediastinal and bronchial nodes were invaded in less than one-half of the cases, while the lung appeared to be an infrequent site. Age in no way influenced the growth. The metastases at seventeen were not more extensive than were those of sixty.

TABLE II

Epithelial Tumors Arising from Skin and Mucous Membrane

Age	10–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90
Skin		1	2	2	1			
Tongue				3	4	1		
Pharynx, Larynx, Trachea			1	1	5	1		
Lung		1	6	14	11	3		
Œsophagus			2	23	30	20	4	
Stomach		6	21	54	59	44	17	4
Intestine	1	4	6	10	15	19	5	2
Rectum			3	4	7	9	1	
Urinary Bladder			1	5	9	9	2	1
Gall-bladder			4	7	12	6	2	1
Cervix and Uterus		1	6	11	4			

Epithelial Tumors Arising in Glandular Organs

Breast		2	2	15	11	5	3	
Prostate		1	4	5	10	9	10	1
Testicle			2		1			
Kidney		3	2	6	8	3	3	
Adrenal			1	3	1			
Pancreas			2	7	11	10	3	
Liver		2	10	6	5	10	4	

The breast was the primary site in two cases, both females. In one, the metastases widely involved the lymph-glands, in the other, besides the nodes, the lung, liver and rectum were invaded. It occurred in the prostate in one case. From the number of other structures involved, it would be difficult to state whether the tumor, at this site, was primary or secondary. Six of these tumors were thought to have originated in the lung, all occurred in males and at the average age of fifty years. Two-thirds of them extensively involved the lung, but did not invade other tissues. Of the remaining two, one metastasized to ribs and dura, the other to the kidney.

There were eleven primary tumors of bone, five of which occurred in the femur, three in the lower end of the tibia, two in sternum and ribs and one in the vertebræ. The average age was forty-four years and there were eight males to three females. Most of these tumors metastasized to the lung. A few were bizarre in their selection; for one from the ankle metastasized to the scalp, another from the femur to the heart, another from the sternum and ribs to the liver, while still another, an osteosarcoma of the right ankle, metastasized to the femoral glands.

Under the diagnosis of endothelioma of the dura were eleven cases. Their main interest lies in their benign character, for none of these tumors metastasized.

Brain.—Number of cases, eight—average age, twenty-seven, with extreme variations of from three to fifty-five years. Half of these cases occurred below twenty years, while three of this number were below ten. Sex, four males, four females. In five of the eight cases the condition was that of a glioma. Of the remaining three, two were spongioblastomas and one a neuroblastoma. All of these neoplasms were of local growth.

Spinal Cord.—Number of cases, three—average age, forty-nine years. Sex, males two, females one. None of these tumors metastasized.

Eye.—Number of cases, one. It occurred in a male, aged four years. This neoplasm involved the optic nerve and metastasized distantly to the liver.

Comment.—In analyzing this series of cases, certain features present themselves as being of unusual interest. Briefly stated, they are as follows:

(1) The average age for all malignant tumors at autopsy was fifty-one. Men seem to be affected somewhat later in life than women. Tumors arising in the female organs of reproduction apparently occur at an earlier age than do those arising in other organs of the body. Malignant connective tissue tumors usually occur in the earlier decades of life, for the average age was forty-five years.

(2) The sex ratio of three males to one female would seem to be an exaggerated one, the probable explanation being that more males are autopsied than females. However, the ratio for œsophagus, stomach and intestines corresponds with the surgical ratio compiled from the combined records of the Presbyterian and French Hospitals, and from the First Surgical Division of Bellevue Hospital.

(3) The site of many of these tumors seems to a marked degree to be influenced by sex, as, for example, there are no necropsy records or surgical records on the First Division of an epithelioma arising from the mucous membrane of the mouth or tongue in a female. From the same records there are but two epitheliomas of the œsophagus occurring in women. In the stomach, the ratio is a little over three to one, while in carcinoma of the intestinal canal, the ratio is more nearly equal.

(4) Excepting in the very aged, age does not seem to influence metastases, for tumors occurring in those below thirty were not, as a general rule, more widely distributed than they were in those of fifty or sixty years. In the aged, the neoplasm was usually of local growth.

(5) In carcinoma of the stomach and intestines, the immediate cause of death in about 15 per cent. of the cases was perforation and peritonitis. It is interesting to note in this connection that, in the majority of these cases of the intestine, only definite symptoms were those of peritonitis.

(6) About 69 per cent. of the malignant epithelial tumors arising in, or from, the skin and mucous membrane remained local in their growth, invading either the neighboring lymph-glands and adjacent tissues or both, while

only 28 per cent. of the cases arising in glandular organs showed the same local tendency of growth.

(7) One of the very interesting findings in this review was the number of cases that showed only local invasion of the neighboring tissues and adjacent lymph-nodes. Perhaps, what is even of greater interest, are the cases in which the neighboring nodes were alone involved. This held true for carcinomata regardless of their site of origin, but were much more frequently found in the cases whose site of origin was the stomach, large intestine, urinary bladder and cervix.

(8) The most interesting feature of this series is the number of cases of supposedly malignant tumors that did not metastasize. Out of 770 morphologically malignant epithelial neoplasms, 187 showed no obvious evidences of metastases. In the stomach and large intestine, 15 per cent. of the cases were of local growth, this fact being particularly emphasized in many of the autopsy protocols. Any attempt to explain these findings would at least be speculative. Two, however, may be considered, as they seem to be supported by a certain amount of evidence: (*a*) the existence of two types of tumors, both of which show the same microscopic picture and react in a similar manner to the tissues in which they originate, but otherwise are dissimilar, for the course of one is that of a metastasizing tumor, while that of the other is local in its growth; (*b*) that all tumors of this type are potentially malignant, but their future course is guided and controlled by some factor or factors, which, for purposes of convenience, may be called resistance.

Perhaps the true explanation of why some malignant neoplasms diffusely metastasize and others do not may be entirely a matter of virulence and body resistance. To reason by analogy, from bacterial infections to malignancy, may not be tenable, but in any event both have enough in common to raise the question as to whether or not virulence and body resistance, are not the guiding factors in the growth of all malignant neoplasms, as they seem to be in all infections.

DESMOID TUMORS*

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In this report appears a brief analysis of the subject of desmoid tumors and particularly of those cases which occurred in The Mayo Clinic in the course of the years 1923 to 1929, inclusive. The cases were studied from the points of view of clinical and pathologic phenomena and of recurrence. Moreover, an analysis as regards recurrence is given of that part of the cases reported by Nichols, which occurred in the course of the years 1910 to 1922, inclusive.

Literature.—The medical literature contains a number of comprehensive studies of desmoid tumors. Especially to be recommended are those by Ledderhose, Pfeiffer, Stewart and Mouat, and Powers. Nichols' communication in its entirety was concerned with those cases which occurred in The Mayo Clinic from 1904 to 1922, inclusive.

Petresco and Noveleano reviewed, with their series, several very large tumors; the tumor reported by Gross and Stewart weighed six kilograms; that reported by Montgomery weighed nine kilograms; and one reported by Rokitansky weighed seventeen kilograms. Petresco and Noveleano described none larger than a "closed fist." Green reported a tumor arising from the fascia of the internal oblique and transversalis muscles, which measured twelve, six and ten centimetres in various diameters. Schuman reported, in 1924, the largest desmoid tumor in the recent literature. This tumor arose from the fascia of the rectus muscles and measured twenty, fifteen and twelve centimetres in various diameters. Stewart and Mouat reported, in their series, none larger than a "fetal head." The large tumor of Bodenstein measured twenty-four and twenty-seven centimetres in different diameters. Bouffleur reported a very large tumor, which frequently is referred to, and incorrectly so, for the author himself called this tumor a fibrosarcoma and not a desmoid tumor. It was a rapidly growing, large, vascular tumor of the lower part of the abdomen and pelvis, and had none of the characteristics which have become assigned to the group of desmoid tumors. The report of Nichols did not contain reference to large tumors.

Presumably due to the campaign of education of the public conducted by the medical profession, the very large desmoid tumor of the earlier literature has disappeared, since aid is sought by the patient soon after the tumor is discovered.

With regard to recurrence, the largest series was studied by Pfeiffer. He reviewed 107 post-operative cases and found recurrences in thirty-three

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(30.8 per cent.). Of the 107 cases, eighty-five occurred among women, with relapse in eighteen; thirty-two occurred among men, with relapse in fifteen. Pfeiffer also stated that the smaller the growth and the more radical the excision the less the likelihood of recurrence. He called attention to the great difficulty of correct diagnosis of the larger tumors, an opinion which was expressed also by Stewart and Mouat and by Petresco and Noveleano. Stone, who reported a small series of cases, gave a very high proportion of recurrence: 90 per cent. among women and 68 per cent. among men. Stewart and Mouat did not report recurrence at the time of publication of their article, in their series of seven cases.

Etiology.—There was one case in the series observed in The Mayo Clinic in which direct trauma to the biceps muscle of the left arm appeared to be related to the appearance of a desmoid tumor. With this exception, nothing can be added to what has been published elsewhere as regards etiology, although it might be noted that in three instances desmoid tumors of the abdominal wall were found in scars that followed operative procedures.

Symptoms.—This type of tumor seldom has caused symptoms, other than by reason of its presence as a foreign body, or of its size. The tumor, in most instances, is found by the patient, and may be carried for a number of months or years before it is brought to the attention of a physician. Certain of the tumors have been found in the course of a general examination and have been symptomless. The symptoms which cause medical aid to be sought are usually (1) mild sticking pain; (2) sudden increase in size of the tumor; (3) a dragging sensation from weight when the tumor is large; and (4) occasionally the presence of the tumor in such a situation that it interferes with function in one way or another. In the case of a nervous patient the presence of the tumor is a source of many bizarre symptoms.

Diagnosis.—If diagnosis of this type of tumor is to be made, the possibility of its presence must be continuously borne in mind since it is very rare. The fifty cases that form the basis of this report were gathered from a series of patients observed at The Mayo Clinic in the course of the years 1910 to 1929, inclusive.

Desmoid tumors are more frequently found in the abdominal wall than elsewhere, and first of all must be distinguished from malignant tumors. Then there are many benign conditions for which desmoid tumors must not be mistaken, but in this respect confusion usually is easily avoided. Such conditions are large single stone, hydrops or empyema of the gall-bladder, omental tumors, ovarian and other cysts, salpingitis, hematomas of the abdominal wall, appendiceal abscesses, tumors of the pelvis such as osteomas and chrondromas, retroperitoneal tumors, and hernias in one situation or another. The history and general examination together with certain laboratory adjuncts usually will allow distinction between most of them. Desmoid tumors situated in other parts of the body than the abdominal wall present less diagnostic difficulty.

Prognosis.—This condition, by itself, never has been known to cause death. Once a correct diagnosis has been made the tumor can safely be removed and cure will result. Even if differential diagnosis cannot be made, biopsy can be obtained under local anæsthesia, and by the rapid frozen section method developed by Wilson and MacCarty the true nature of the neoplasm can be revealed.

Ewing expressed the belief that the more cellular the structure of the tumor, the greater is the likelihood of recurrence. However, it seems more likely that failure completely to remove the bands of tissue which infiltrate the adjacent muscle is the cause of recurrence of desmoid tumors.

Pathology.—The term desmoid tumor is used at The Mayo Clinic to designate benign fibroma arising from musculo-aponeurotic structures, not only of the abdominal muscles but also of other parts of the body. Since

FIG. 1.—The bandlike arrangement of the tissue in desmoid tumors.

by definition the tumor is benign, the desmoid tumor which contained sarcoma, reported by Donald and Caylor, is not considered in this report, except as a caution that careful histologic and gross study be made of all desmoid tumors.

There are excellent descriptions of this tumor, both gross (Fig. 1) and histologic, in the reports in the literature. The tumor is discrete, very firm, as a rule movable, rounded, of variable size, and may be situated subcutaneously or on the posterior surface of a muscle. In some cases muscle may be palpated over the tumor. The freshly removed tumor is seen to arise from the muscularis aponeurosis; it is pinkish-white, cuts with difficulty and the knife creaks as it proceeds through the tissue. Ewing pointed out that the cut surface resembles neurofibroma, owing to the intertwining bands of connective tissue. Indeed, it was this characteristic which led Johannes Müller to name the tumor desmoid. The larger tumors often give evidence

of central softening, and the history elicited is of rapid enlargement and consequent apprehension as to possible malignant change. The enlargement is due, however, to interference with blood supply and consequent œdema and mucoid degeneration, as was early pointed out by Labbe and Remey.

Histologically, these tumors resemble, at first glance, fibrosarcomas of low grade; however, careful study will show them to be composed of fibres and bands of adult fibrous connective tissue, with nuclei varying in size according to the age of the cell. There never are present nuclei containing large amounts of darkly staining chromatin, nor large multiple nucleoli, both of which are indications of rapid proliferations. There is no capsule or definite line of cleavage between the tumor and the adjacent muscle. In fact, it seems that the tumor begins from a nidus in the aponeurosis, and that the portion adjacent to the muscle begins to infiltrate the muscle fibrils, without causing any tissue reactions (Fig. 1), whereas the opposite side of the tumor grows much larger. There are few hindering structures in this

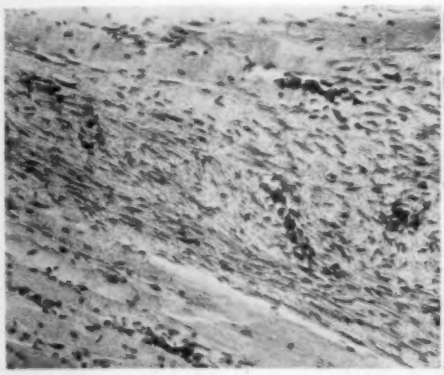

FIG. 2.—Recurrent desmoid tumor. The tumor tissue has infiltrated between muscle fibres (x150).

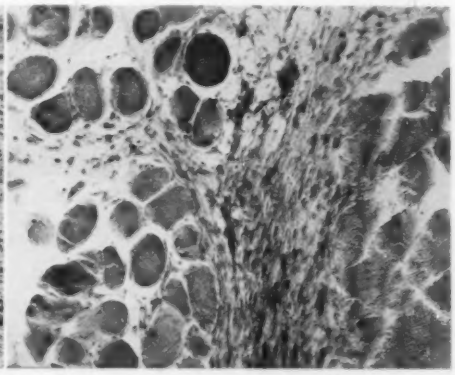

FIG. 3.—Infiltration of a desmoid tumor between muscle fibres. The tumor was removed surgically and did not recur (x115).

direction. That the tumor grows slowly is shown by the presence throughout of normal adult blood-vessels in a high percentage of cases.

Failure completely to remove the tumor surgically will leave strands of interfibrillar desmoid tissue and the tumor will recur. In the literature, or in the series of cases recorded at the clinic, metastasis in regional lymph-nodes or distant metastasis never has been noted. The recurrent tumor is situated at the site of the primary growth. The degree of muscular infiltration does not seem to be of importance; it is about equal in recurrent cases and in cases in which cure has followed operation (Figs. 2 and 3).

Treatment.—The methods of treatment employed by the surgeons at The Mayo Clinic have not varied greatly in the period of twenty years covered by this report.

The growth is removed as widely as the physical conditions will permit, and such portions of the growth as must be allowed to remain are submitted to treatment by radium or deep Röntgen-rays. This procedure is used in

cases of the larger tumors and in cases of tumors which are smaller and have recurred. Many of the smaller tumors may be successfully treated by simple wide excision. The results reported here recommend treatment by radium and Röntgen-rays as an adjuvant to surgical excision, for the use of radium or Röntgen-rays, without operation, has not met with complete success.

Of the cases observed at The Mayo Clinic between 1910 and 1929, inclusive, there were three in which, due to the situation of the tumor, to likelihood of ventral hernia, or to the size of the tumor, only partial excision was done and treatment by radium and Röntgen-rays was instituted. At the time of writing this paper, desmoid tumors had recurred in all of these three cases. In a fourth case, which was included in that part of Nichols' report which we have utilized, an operation was done for desmoid tumor of the abdominal wall. The patient returned one year later. A tumor had not recurred at the site of the primary operation, but the patient did have an independent desmoid tumor at the orifice that had been made at a previous ileocolostomy and another independent desmoid tumor just above the symphysis pubis. These later, independent tumors were unsuccessfully treated by Röntgen-rays and radium.

ANALYSIS OF CASES

Situation of tumors: age and sex and patients.—At The Mayo Clinic, in the course of the years 1923 to 1929, inclusive, treatment for desmoid tumor was instituted in twenty-seven cases. In eighteen cases the tumor arose from the abdominal wall. Fourteen of the patients were women, of whom ten had been pregnant one or more times previous to the appearance of the growth. Ten of the fourteen patients were aged from twenty to forty years. The four male patients were between the ages of twenty and sixty years.

In nine cases there were desmoid tumors elsewhere than in the abdominal wall: two in the muscles of the thoracic wall; one in the sternomastoid muscle; one in the biceps muscle of the left arm; one in the scapular region; one in the left extensor carpi ulnaris muscle; one in the left rectus femoris muscle; one in the group of muscles which combine to form the tendons bounding the left popliteal space, and one in the right masseter muscle. There were five men and four women in this group.

The cases reported by Nichols which occurred in the course of the years 1910 to 1922, inclusive, involved twenty-two cases in which there was one tumor each and one case, which has been mentioned in the section on treatment, in which there was one initial tumor and, later, two independent tumors. In twenty-one of these twenty-three cases, including the case of multiple tumors, the growths were in the abdominal wall; in two cases the growths were in other regions.

Recurrence.—Questionnaires were sent to the patients. By replies to

TABLE I

Desmoid Tumors of the Abdominal Wall Seen at The Mayo Clinic, 1923 to 1929, Inclusive

Case	Age, years, and sex	Pregnancies	Position and origin of tumor	Size, centimetres and weight, grams	Duration before treatment, months	Treatment	Date of operation*	Recurrence
1	20 F	1	Right lower quadrant of abdomen	10 by 9 by 6 264	9	Surgery and radium	April 7, 1927	No reply
2	28 M		Upper right rectus muscle	3 by 2	23 years	Surgery	August 7, 1924	None February 27, 1930
3	28 F		Left internal oblique muscle	7 by 6 by 4	10	Surgery	October 29, 1923	No reply
4	23 F	2	Left internal oblique muscle	2.5 by 2	?	Surgery	January 29, 1926	None February 19, 1930
5	36 F	3	Scar in right rectus muscle	6.5 by 9.5	2 or 3	Surgery and radium	March 23, 1928	2.5 by 3.75 centimetres; 6 radium treatments
6	39 F	3	Scar in left rectus muscle	10 by 9 by 7	2	Surgery	October 25, 1926	Noted December, 1926; removed elsewhere January 22, 1928; none since
7	35 F	2	Right rectus muscle	7 by 7	12	Surgery	September 4, 1929	No reply
8	25 F	1	Internal oblique muscle	3.5 by 3.5	2	Surgery	March 31, 1928	None February 10, 1930
9	26 F	1	Right internal oblique muscle	5 by 4 by 3	12	Surgery	March 11, 1924	None March 6, 1930
10	34 F	5	Right internal oblique muscle	4.5 by 2 by 2	15 years	Surgery	March 21, 1924	No reply
11	2 F		Left rectus muscle	5 by 5	12	Surgery and radium	October 25, 1927	In scar 1 year after operation 3.75 by 6.75 centimetres at present time

TABLE I—(*Continued*)

Case	Age, years, and sex	Pregnancies	Position and origin of tumor	Size, centimetres and weight, grams	Duration before treatment, months	Treatment	Date of operation*	Recurrence
12	50 F	1	Scar in abdominal muscles	3.5 by 3.5	24	Surgery and radium	August 17, 1928	November 4, 1929
13	49 F		Right iliac region	12 by 6 by 5 150	7	Surgery and radium	July 13, 1928	None February 25, 1930; hernia present
14	24 F	1	Right internal oblique muscle	4 by 3 by 3	5	Surgery	September 11, 1928	No reply
15	35 F		Right iliac region	95	2	Radium and surgery	July 4, 1929	Very little remained March 8, 1930
16**	32 M		Left lower quadrant	17 by 8 by 4 8.5 by 7 890	36	Surgery and radium	December 23, 1929	Small amount remained April 2, 1930
17	54 M		Right rectus muscle	7 by 3 by 1	21	Surgery	November 12, 1924	Died November 17, 1924; sepsis
18	67 M		Left internal oblique muscle	4.5 by 4 by 3	6	Surgery	January 18, 1924	None February 25, 1930

* Immediate post-operative condition of patient good in all cases except case 17.

** This is the largest tumor removed in The Mayo Clinic series, 1904 to 1929, inclusive.

TABLE II

Desmoid Tumors Situated Elsewhere Than the Abdominal Wall, Seen at The Mayo Clinic, 1923 to 1929, Inclusive

Case	Age, years, and sex	Pregnancies	Position and origin of tumor	Size, centimetres	Duration before treatment, months	Treatment	Date of operation*	Recurrence
19	60 M		Left pectoralis major muscle	6.25 by 7.5	2	Surgery and radium	May 8, 1927	None February 27, 1930
20	4 M		Left sternocleidomastoid muscle	3 by 3	2.5 years	Surgery and radium	October 6, 1925	None March 15, 1926
21	12 F		Left ham strings	10 by 10	12	Surgery and radium	July 11, 1929	None March 10, 1930
22	24 F	2	Left extensor carpi ulnaris muscle	9 by 5 by 4	24 years	Surgery	April 22, 1929	None April 2, 1930
23	60 M		Rectus femoris muscle	2 by 2	3	Surgery	October 18, 1928	None February 27, 1930
24	40 F	2	Right side of thorax	3.5 by 2.5 by 2	4 years	Surgery	July 21, 1928	None March 3, 1930
25	38 M		Right masseter muscle	3 by 1.5 by 2.5	2	Surgery	November 3, 1928	None February 25, 1930
26	47 M		Right scapular region	5.5 by 2.5 by 1.5	6 or 7 years	Surgery	June 16, 1928	None February 24, 1930
27	32 F	3	Trauma; left biceps of arm	8 by 6 by 3	9	Surgery	June 4, 1924	July 20, 1928; removed elsewhere

* Immediate post-operative condition of patient good in all cases.

these inquiries or by other means, data concerning recurrence were obtained relative to thirty-nine of the fifty patients.

As has been pointed out, abdominal desmoid tumors were removed in eighteen cases between 1923 and 1929, inclusive. In one case the patient died from sepsis five days after operation and the case cannot, therefore, be included in estimations concerning recurrence. Excluding this case, data concerning recurrence were available by questionnaire or otherwise in twelve cases. The failure of irradiation to prevent recurrence in three cases has been related in the section on treatment. In nine other cases of this group of twelve, surgical operation was the major procedure and, in some, incidental treatment by Röntgen-ray or radium was given. Recurrence was reported in three cases; two of the patients were women of child-bearing age who had had one or more pregnancies, and the third patient was a child aged two years. In all of the nine cases in which desmoid tumors occurred in situations other than the abdominal wall, follow-up data were obtained; in one case recurrence was reported.

Of the twenty-one cases in Nichols' series, in which there were abdominal tumors, data concerning recurrence were available in seventeen. Recurrence had not taken place in any case of this group. In two cases in which desmoid tumors had occurred in regions other than the abdominal wall, it was learned that recurrence had not taken place.

SUMMARY

At The Mayo Clinic, in the course of the years 1910 to 1929, inclusive, fifty patients with desmoid tumors were seen.

Thirty-nine, or 78 per cent., of the fifty patients either answered questionnaires concerning recurrence of the tumor or else the desired information was available otherwise.

Among the cases in which the tumor was in the abdominal wall, data concerning recurrence were available in twenty-nine.

In ten cases in which a desmoid tumor was situated elsewhere than in the abdominal wall, a reply to the questionnaire was received. Recurrence was reported in one case.

In three cases in which treatment was mainly or entirely by radium or Röntgen-rays, recurrence took place, and in a fourth case the treatment was unsuccessful otherwise.

In thirty-five cases surgical operation was either the only method of treatment applied or was the principal method. Recurrence is known to have taken place in four cases.

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HERNIA OF THE UMBILICAL CORD (EXOMPHALOS)

By Alec Horwitz, M.D.
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The rarity of umbilical cord hernia justifies the following report:

A male child, referred by Doctors Kotz and Eanet, presented a globular mass about ten centimetres in diameter, at the umbilicus. The mass, which extended into the umbilical cord, contained intestinal coils which could be seen through the thin covering of "Wharton's jelly." The child, only a half-hour old, cried lustily and showed no other congenital defects. The hernial opening was about four centimetres in diameter. By lifting the abdominal wall on either side, the contents of the hernia were reduced but recurred immediately on the release of the abdomen. Without any anæsthetic a purse-string suture of chromic catgut was placed in the skin about a half centimetre from the junction of skin and cord, care being taken not to enter the peritoneal cavity. The hernia was now reduced again and the purse-string suture tied firmly. The excess cord was cut away and a flat piece of metal, about five centimetres in diameter, covered with gauze, was placed over the umbilicus and the abdomen was strapped tightly with adhesive.

Except for an inanition fever which was present for several days and which disappeared after the addition of artificial feedings, the convalescence was uneventful. The child was circumcised on the eighth day and dismissed from the hospital on the fourteenth day. The abdomen was still protected with an adhesive tape binder.

Hernia of the umbilical cord is an extremely rare condition. Lindfors gives the incidence as one in 5,184 births, Balantyne 1 in 5000, Watson 1 in 10,000. Only four cases of hernia of the umbilical cord were met with in over 75,000 cases of hernia in the Hospital for Ruptured and Crippled in eighteen years. Hebert (1928) gives figures from a number of hospitals which corroborate more or less the above figures.

Etiology.—The cause of umbilical cord hernia is a developmental defect. The underlying cause is still a moot question. It is, of course, known that from the fourth week to the tenth week of embryonic life there is present a physiological umbilical cord hernia. When the primitive gut is differentiated into recognizable regions, the intestinal region forms a simple tube of uniform diameter, extending from the stomach to the caudal end of the embryo, where it ends blindly. As the stomach changes its position the rest of the intestine forms a loop which extends ventrally and caudally as far as the umbilicus. The arms of the loop are almost parallel and are placed one cephalic and one caudal. The apex of the loop extends into the umbilical celom and is attached to the yolk stalk. Very shortly after the formation of the long loop in the intestine six bends become recognizable in the cephalic arm of the loop between the stomach and the apex. These bends form distinct loops which are destined to become the small intestine. The first loop is the duodenum which is fixed *within* the abdomen, but the other loops continue to elongate and form secondary loops. All of these push their

way into the *umbilical celom* until the embryo reaches a length of 40 millimetres.

Some think that the enlargement of the liver at this time pushes the intestine out into the umbilical celom and when it decreases the intestine returns. Others believe that reposition takes place because of the pull on the omphalomesenteric vessels when the liver grows caudally towards the pelvic cavity. As to why this physiological hernia persists there are many views. Ahlfred claims it is due to incomplete closure and constant pull of the vitelline duct. Sievers mentions many other theories only to show that they have been made to conform to a certain case presented. Scheffzek reports a case which he thinks was caused by a fetal peritonitis during the second month of embryonic development and that the adhesions formed caused the persistence of the hernia. Aschoff mentions as a possibility the persistence for a longer time than usual of the dorsal concavity of the vertebral column which in turn causes a decrease in the size of the abdominal celom. This forces the intestine to develop in the umbilical celom and causes a persistence of the hernia. Cummins, in discussing Hebert's three cases, divides the types of exomphalos into two grades: (1) small herniæ, due to persistence of the physiological hernia; (2) larger herniæ, due to lack of closure of the somatopleure and amnion which progressively grow toward the yolk stalk to form the anterior abdominal wall. He states further that it is accepted by modern embryologists that any maldevelopment may arise through the action of a single causative factor. Selectivity depends on the embryonic period the influence is brought to bear. In umbilical cord hernia he would seek the cause in endometrial pathology, materual toxæmias, and similar causes. Sievers explains that a single defect may start a train of other defects because of a correlative development of other organs which are dependent on the process first disturbed. As an example is his case of an umbilical hernia which was complicated by a diaphragmatic hernia and a partial situs inversus. And so we find other cases reported which are accompanied by other congenital defects such as a patent Meckel's diverticulum, ectopia vesicæ, or other intestinal, hepatic or genital defects.

The coverings.—The coverings of the hernia are (1) a thin membrane continuous with the parietal peritoneum (called by Cannon Rathke's membrane); (2) "Wharton's jelly;" and (3) the thin amniotic layer covering the cord. Cannon objects to the term hernia but calls it an exomphalos.

Diagnosis.—The diagnosis is fairly easy if the hernia is large, but the condition should be kept in mind because a small knuckle of intestine could easily be tied off with the cord.

Prognosis.—In small herniæ the prognosis is good. In larger herniæ the prognosis is dependent on the time that has intervened between birth and operation. The earlier the operation the better the prognosis. Certainly complications such as strangulation, incarceration or the complicating defects lower the chances for recovery. Non-operated herniæ showed a mortality of 75 per cent. according to McDonald, who reported twelve cases.

Treatment.—Small herniæ can be treated by bandage compression. Large herniæ should be treated by extraperitoneal operation, incising the skin if necessary to allow closure of the hernial opening. If absolutely necessary because of the irreducibility of the hernia or because of strangulation, intraperitoneal operations can be done, care being taken not to overlap too much in the repair of the abdominal wall. Anæsthetics used varied from chloroform and ether, to local anæsthesia. In some cases, as in the one reported,

no anæsthesia whatever was used. Sievers advocates avertin with addition of ¼ per cent. novocaine with adrenalin locally, if necessary. It would seem advisable to operate on these cases immediately after they are recognized, if operative intervention is indicated; for if delayed, the amnion and peritoneum become glued together and the operation is then much more hazardous.

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD APRIL 23, 1930

The Vice-President, Dr. John Douglas, in the Chair

ACUTE DEFERENTITIS WITH ABSCESS FORMATION

Dr. Ralph Colp presented a man, aged forty-one, who was admitted to the Surgical Service of Doctor Lewisohn, Mt. Sinai Hospital, November 14, 1929.

At the age of twelve, he had a swelling of the left leg which lasted for five years. Eight years ago he had a chill lasting for two hours, associated with scrotal swelling and redness. The œdema of the scrotum lasted one week. Four years ago he had a chill lasting two hours, associated with chylemia, the latter persisting about two months. For the past twenty years he has had a left inguinal hernia. Nine days before admission, the inguinal mass became seemingly irreducible and tender, and the patient vomited several times.

The physical examination at time of admission was practically negative except for the local surgical condition in the inguinal region. From the region of the external ring to the scrotum, a hard, firm mass, slightly tender, presented itself. The mass extended into the scrotum displacing the testicle which felt normal. The mass did not transilluminate. No impulse was felt on coughing; prostate normal; temperature and pulse normal; urine examination and blood count normal.

Under local anæsthesia, an inguinal incision was made. The aponeurosis of the external oblique was incised in the direction of the fibres. The spermatic cord was found markedly thickened and very œdematous. Aspiration of the cord revealed a thick, odorless, yellow pus. The cord was incised and the pus evacuated. The vas was thickened to four times its normal diameter, the veins were not thrombosed. The abscess cavity was packed with iodoform gauze and the wound was partially closed.

The Wassermann was negative and several examinations of the blood failed to disclose the presence of filaria. Tissue removed from the abscess showed infected granulations. The bacteriology of the pus was streptococcus hemolytic beta.

Patient made an uneventful recovery following the operation.

Dr. Colp presented a second man, aged fifty-nine, who was admitted to the Surgical Service of the Beekman Street Hospital, January 11, 1929, complaining of a difficult urination which dated back over eight years. He has to be catheterized very often because of a stricture of his urethra, following a Neisserian infection contracted twenty years ago. He states that he has had severe shaking chills at intervals of about six months for the past seven or eight years but he believed that this usually followed a catheterization. Two days before admission he complained of a tender mass in the right groin which seemed to appear quite suddenly. He had no gastro-intestinal symptoms and no preceding hernia.

Examination disclosed in the right inguinal region a mass the size of a tangerine orange. This mass was tender and immovable and no impulse was

elicited on coughing. The scrotum and its contents felt normal. The rectal examination was negative. The temperature and pulse were normal. The urine examination disclosed pus and albumin. The blood count was normal.

Under spinal anæsthesia, an inguinal incision was made on the right side. The aponeurosis of the external oblique was incised. The spermatic cord was found to be thickened and œdematous. In mobilizing the cord, a definite abscess containing about a dram of foul-smelling pus was encountered. This apparently arose from a definite visible perforation in the vas which was markedly thickened and irregular. The wound was packed with iodoform gauze.

Following operation, patient ran a temperature between 110° and 102° for three days. The blood count was normal. Then on the fourth, fifth and sixth days he had a severe shaking chill with temperature of 105°. Examination of the blood smears showed the parasites of tertian malaria. From the type of daily chill, evidently a double tertian infection was present. Following the administration of quinine, temperature returned to normal and he was finally discharged, the wound healing by secondary intention. At the present time the patient is well, although a large direct inguinal hernia is evident.

Cases of acute deferentitis and funiculitis are moderately rare, and may be subgrouped into three general varieties: acute gonorrhœal deferentitis and funiculitis, acute streptococcus funiculitis (known as the endemic variety, and invariably due to a thrombophlebitis of the veins of the pampiniform plexus) and those cases of funiculitis of indeterminate origin in which the pathology is obscure. The two cases now reported probably belong to this group. While in a series of thirty cases of funiculitis reported by Menocal the etiological factor was filaria, no present evidence of this condition could be found in Case No. 2, although the patient suffered from filariasis in the past.

Case No. 2 was probably caused by a focus in the posterior urethra reaching the cord either via the lymphatics or by retrograde peristalsis of the vas. While a deferentitis may involve simply the three coats of the vas, perforation may result as in Case No. 2 or the surrounding structures of the cord may be involved by contiguity resulting in a funiculitis. The treatment of these cases was simple. Following incision and drainage the condition rapidly subsided.

ANEURISM OF THE SUBCLAVIAN ARTERY

Dr. Ralph Colp presented a man, aged fifty-seven, who was first admitted to the Beekman Street Hospital on August 6, 1929.

The chief complaint was that of a throbbing mass on the right side of the neck. On February 18, 1929, he fell from a truck, injuring the right arm and shoulder. The region became very painful and swollen, and he received treatments of baking and massage for some time with fair results. About February 22, 1929, he noticed a mass about the size of a walnut just above the middle part of the right collor bone. The discovery of the mass was accidental and there was no discomfort in this region then. The mass continued to grow in size for the next four months and then the patient became conscious of a dull, throbbing sensation over the upper part of the right chest, most marked following physical exertion. Shortly after the accident, the arm, forearm and hand became swollen and painful; in fact, because of the swelling, the entire right upper extremity soon became almost useless.

The past history is practically irrelevant, lues being denied by name and

symptoms. The man was a well-developed negro. In the supra-clavicular region arising about three inches above the middle portion of the right clavicle was a mass the size of a lemon which pulsated and was expansile and through which the heart sounds could be heard. The anterior wall of the tumor seemed formed by the outer two-thirds of the clavicle. No mass or abdominal pulsation was felt in the axilla. The apex beat of the heart was felt in the fifth space outside the mid-clavicular line. There was dulness to the right of the sternum and dulness from the base to the mass. Apex beat was strong and regular and the heart sounds appeared normal.

The right upper extremity was swollen and tender and seemed to be about twice the size of the other arm. Motion was definitely restricted because of the œdema of the extremity. Left arm blood-pressure, 130/95, right arm blood-pressure, 120/70.

Under X-ray examination, at the root of the neck on the right side, lateral to the apex of the lung, there was a diffuse and considerable increase in density of the soft tissues as compared to the left side. This would be quite compatible with a subclavian aneurism. The process does not extend down into the chest.

Urine examination, negative; blood count, normal; Wasserman reaction, four plus.

The patient refused operation at this time but was subsequently readmitted on August 30, 1929, when it was decided to ligate the first portion of the subclavian artery for aneurism of the second portion of the artery. The operation was performed under gas, oxygen and ether anæsthesia. A four-inch incision was made over the clavicle from the junction of the middle and inner third to the sternal origin of the sternomastoid muscle, and then prolonged upward along the anterior margin of this muscle to the extent of three inches so as to make the letter "V." This, together with the underlying platysma, was dissected upward. The inner one-third of the clavicle was freed from its attachments and resected. The sternomastoid, the sternothyroid and sternohyoid muscles were then divided at their sternal attachments between clamps. The deep fascia of the neck was then divided and the internal jugular vein was dissected from its sheath and drawn laterally. The common carotid artery, together with the vagus nerve, was drawn mesially and the subclavian artery was identified and freed from the surrounding structures, care being taken not to damage the phrenic nerve. With an aneurism needle, a braided white silk ligature was placed about the first portion of the subclavian artery lateral to the common carotid and the artery was obliterated to about three-fourths of its diametre, three-eighths inch distal to this ligature on the aneurism side a chromic No. 4 ligature was tied around the artery tightly. Pulsations were seen to disappear immediately from the aneurism sac and it was seen to grow smaller. The aneurism sac itself was surrounded by dense fibrous tissue and no branches of the thyroid axis were apparent with the exception of the transverse cervical. The divided muscles were then united with interrupted plain catgut sutures, the deep fascia of the neck together with the platysma were closed with interrupted plain and the skin approximated with silk. Immediately following the operation, the condition of the patient was unusually good, although no pulsations could be felt in his radial or ulnar arteries.

On the first post-operative day there was less swelling of the right arm although the radial pulse was completely obliterated. Three weeks later the swelling and œdema of the arm were materially lessened and the patient was able to move his arm fairly well and was able to close his hand. The swelling

of the neck was about the same although there was no pulsation and it seemed firmer.

At present the patient is quite well. The supraclavicular mass is still present, although smaller, softer and without pulsation. There is practically no swelling of the extremity and all movements are almost normal. The radial pulse is present; the blood-pressure is 120 and the oscillometric reading is four millimeters as compared with a blood-pressure of 130/95, and an oscillometric reading of twelve millimeters of the normal left extremity.

Oscillometric Readings and Blood-pressures

	Right arm	*Left arm*
September 3, 1929.	Reading two millimetres B. P. 120. Hand swollen to about twice the normal size. Function markedly impaired.	9 B. P. 130/95
September 3, 1929.	Operation.	
September 4, 1929.	Reading three-quarter. B. P. of 100. Swelling of hand much less. Radial pulse obliterated.	—9
September 5, 1929.	Reading one-quarter. Hand colder. Swelling the same.	—9½
September 6, 1929.	Reading one-half millimetre. Hand warmer. Swelling the same. B. P. 100	—9 B. P. 120/90
September 7, 1929.	Reading one millimetre. Hand warmer. Function of fingers improved. Swelling decreasing.	—9½
September 9, 1929.	Reading one millimetre.	—9
September 11, 1929.	Reading three-quarter millimetre. Function of fingers improving.	—9
September 14, 1929.	Reading one millimetre. Function of fingers improving.	—9½
September 18, 1929.	Reading one millimetre. No radial pulse palpable.	—9
September 22, 1929.	Reading one millimetre. No radial pulse palpable.	—9
September 24, 1929.	Reading one millimetre. Very little limitation of motion of arm.	—9½
May 18, 1930.	Reading four millimetres, B/P 120. No limitation of motion of arm, forearm and hand, and practically no swelling.	—12 B. P. 130/90

This case is shown as a possible example of a traumatic aneurism engrafted upon a syphilitic basis. It is an aneurism of the second portion of the right subclavian artery, which is comparatively rare. While excisions of aneurismal sacs have been reported and endoaneurismorrhaphy results have been permanent, it was felt that simple ligation of the proximal portion of the artery was the operation of choice. This was, in itself, a comparatively simple procedure, especially following the technic outlined by Eliot in the ANNALS OF SURGERY, Volume LVI, p. 83. To have ligated the branches of the second portion of the vessel would have entailed much dissection, which probably would have resulted disastrously. Proximal ligation of the aneurism in this case certainly produced definite improvement in relieving the patient of a conscious throbbing and in reducing the œdema of the right upper extremity.

The supraclavicular mass is still present, although somewhat smaller. Whether a recurrence of this condition will take place a follow-up will tell.

DR. FRANK S. MATHEWS said that he once had a case of subclavian aneurism similar to Doctor Colp's, even to the plus four Wassermann. His patient had lived ten years after ligation of the vessel in comparatively good health. The operative procedure had consisted in dividing the clavicle, applying a distal catgut ligature and, as the proximal ligature had to be applied very close to the aneurism, making use of a fascial suture wrapped twice about the vessel.

ECHINOCOCCUS CYST OF THE LIVER

DR. RALPH COLP presented a man, a Maltese, aged thirty-eight, who was admitted to the Beekman Street Hospital December 16, 1927, and discharged

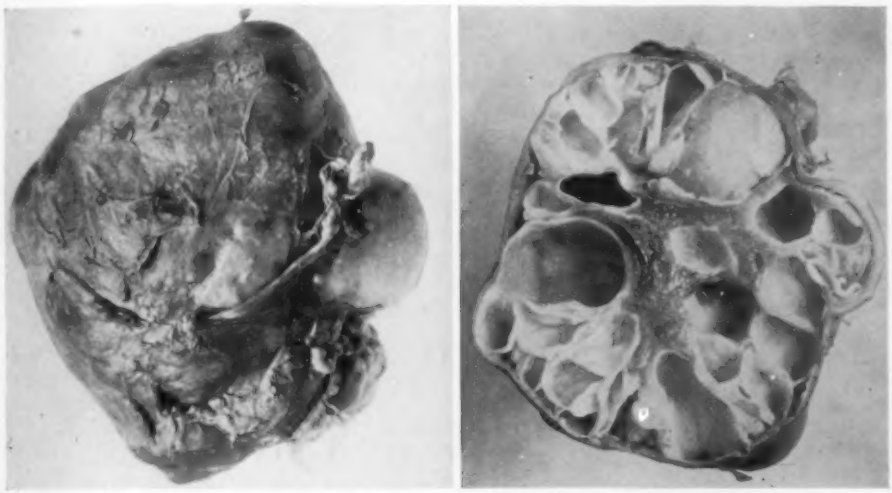

FIG. 1.—Echinococcus cyst of the liver.

December 21, 1927. His occupation was that of ship cook. He was readmitted March 28, 1928, for operation.

On the evening of his first admission, during a street brawl he was struck in the epigastrium; two hours later he vomited and fainted. An hour later he vomited again was brought by ambulance to the hospital suffering from pain and tenderness in the epigastrium.

He was a well-developed young white man, not appearing acutely ill. The abdomen was soft without rigidity, but tenderness was definitely present in the epigastrium. A mass was palpable occupying the epigastrium and extending into the left hypochrondrium. It was round, slightly irregular, seemingly cystic and not tender. It moved with respiration and was apparently attached to the liver. He stated that it had been there for about ten years.

X-ray examination of the abdomen revealed the presence of a cystic mass attached to or part of the right lobe of the liver, and, with the patient prone, it pressed out the duodenum, together with the pyloric antrum of the stomach, into the thin line. In the standing position there was no such deformity. The mass was definitely above the stomach and duodenum. (Fig. 1.) The stomach

and duodenum were empty in six hours, as well as all of the small intestines, excepting the terminal ileum.

X-ray of his chest showed no evidence of any echinococcus disease. The blood count was 7,100, with 78 per cent. polymorphonuclear leucocytes. No eosinophilia was present. Urine examination was normal, the Wassermann was negative.

He was advised to have an operation, and for this purpose was subsequently admitted March 28, 1928.

At operation a median incision was made reaching from the ensiform to the umbilicus. A large multilocular cyst mass (Fig. 1) was seen arising from the right lobe of the liver. This measured about ten inches in length with an average diameter of six inches. It was oval, irregular, lobulated and in some areas definite calcification seemed present. There was definite crackling in some of the cysts, but no thrill could be elicited. Adherent to the cyst wall in several areas were dense firm omental adhesions. There were no cysts to be seen or palpated elsewhere within the abdomen. The omental adhesions of the cysts were deligated, the right coronary ligament, the round ligament and the suspensory ligament of the liver were ligated and by this maneuver, the cyst was mobilized more freely. A line of demarcation was found between the cyst wall and the liver and the cyst was enucleated by blunt dissection. The under surface of the liver was packed with a Mikulicz tampon of iodoform and plain gauze. Two rubber drains were placed down toward the gastro-hepatic omentum.

Patient stood the operation itself unusually well. Within twenty-four hours, however, he began to vomit and abdominal distention became marked. However, with the administration of continuous intravenous 5 per cent. glucose and colon irrigations, this distention and vomiting disappeared, and seven days after operation his condition was excellent.

On the ninth day after operation while attempting to get out of bed, he disrupted his abdominal wound and several feet of small intestine protruded. Under chloroform anæsthesia, the intestines which had prolapsed into the wound were washed with saline and reposited into the abdomen and the wound closed with through and through silk sutures. Twenty days after operation all sutures and drainage were removed.

The patient was seen several months after operation, at which time he was well. Since then all attempts at follow-up have been unsuccessful.

Dr. Walter A. Sherwood asked if the history of this man had shown any association in his earlier life with sheep-herding dogs. A few years ago the speaker reported three cases with echinococcus cyst of the liver; one came from Sicily, one from Greece and the third from one of the Balkan States. Each of them had formerly lived in families where the principal occupation had been the raising of sheep and each had been in close contact with sheep-herding dogs, which is supposed to be the most common mode of infection with echinococcus hooklets.

Dr. Henry H. M. Lyle said that he had two of these cases and both came from Sicily, and both gave the history mentioned by Doctor Sherwood. One of the patients did well after the cyst was taken out; the other had a recurrence and is now under observation. The growth started with a lump in the groin like a hernia and was traced back to the liver.

THROMBOPHLEBITIC SPLENOMEGALY WITH GASTRIC HÆMORRHAGES

DR. RICHARD LEWISOHN presented a woman, forty years old, who was admitted to Mount Sinai Hospital January 23, 1929.

She had had two episodes of epistaxis, melæna, hematemesis and vaginal bleeding. The first attack occurred two years ago, the second six weeks ago. The bleeding lasted about three days. Examination revealed an enlarged spleen. There were no purpuric manifestations and there was no tendency to prolonged bleeding on cuts. Six weeks ago the patient had a recurrence of the bleeding and soon afterward her abdomen became distended. Two weeks before admission she had a paracentesis. Accompanying the ascites there was marked œdema of the face, hands and legs. Wassermann reaction was four plus. The patient has received two courses of antiluetic treatment in the dispensary of Mount Sinai Hospital, the last one in November, 1928.

Status.—The patient was very weak and markedly anæmic. Her pupils were irregular with poor reaction to light. Her spleen was of huge size, markedly enlarged and firm. The liver was not enlarged. Her blood picture (Doctor Rosenthal) showed the following: hæmoglobin, 30 per cent.; red blood cells, 3,100,000; white blood cells, 4,200; polymorphonuclears; 66 per cent.; lymphocytes, 30 per cent.; mononuclears, 4 per cent.; platelets, 200,000. The bleeding and coagulation time was normal. The Vandenbergh test gave: direct, negative; indirect, 1:500,000. The paracentesis (February 8) yielded 6,500 cubic centimetres of yellow fluid. Oxygen was injected for a pneumoperitoneum. X-ray examination showed an enormously enlarged spleen.

February 12.—The patient was given a blood transfusion, 500 cubic centimetres of blood being given by the Unger method, and the hæmoglobin rose to 40 per cent.

February 28.—The patient was given a second transfusion of blood, 750 cubic centimetres being given by the Unger method.

April 2.—Gradual improvement was noticed and there was no recurrence of the ascites. The hæmoglobin rose to 60 per cent.

May 2.—Splenectomy for thrombophlebitic splenomegaly under spinal anæsthesia. An eight-inch left subcostal incision exposed a very large spleen, markedly adherent to the diaphragm. The adhesions were divided and the pedicle was clamped. The abdominal wall was then sutured in layers without drainage. The specimen showed sinus hyperplasia and endophlebitis of the splenic veins.

The post-operative course was uneventful, except for a low-grade temperature which subsided spontaneously after two weeks. A test meal (May 30) showed achlorhydria. The patient was discharged June 18. She is now in excellent condition and has had no recurrence of hæmorrhage.

The last blood report (February 21, 1930, Doctor Rosenthal) was as follows: red blood cells, 4,500,000; white blood cells, 7,600; platelets, 320,000; lymphocytes, 45 per cent.; monocytes, 10 per cent.; polymorphonuclear eosinophiles, 2 per cent.; polymorphonuclear basophiles, 2 per cent. One of the interesting features of this case is the spontaneous disappearance of the ascites before the splenectomy. This phenomenon might possibly be explained by a tunneling of the previously occluded portal system. The patient has gained 20 pounds in weight since the operation; the hæmorrhages have not recurred.

DR. LEWISOHN presented also a young girl, seventeen years old, who was admitted to Mount Sinai Hospital March 24, 1928. Six weeks prior to admission the patient had a severe gastric hæmorrhage. During the next three days she had eight more hæmorrhages and was admitted to another hospital where

transfusion was performed. At that time she had a hæmoglobin of 25 per cent. and her red blood cells were 1,500,000. She stayed in that hospital for about one month, during which time her hæmoglobin rose to 45 per cent. and her red blood cells increased to 2,500,000. Her stool contained blood at times. One day before her admission to Mount Sinai Hospital she had three hæmorrhages. When admitted she was markedly exanguinated. Her blood examination (Doctor Rosenthal) showed: hæmoglobin, 30 per cent.; red blood cells, 2,500,000; white blood cells, 12,600; platelets, 260,000; polymorphonuclears, neutrophiles, 76 per cent.; eosinophiles, 2 per cent.; basophiles, 1 per cent.; myelocytes, 1 per cent.; lymphocytes, 10 per cent.; monocytes, 7 per cent. The fragility test revealed: partial hæmolysis, 0.48-0.32 per cent.; complete 0.30 to 0.26 per cent. She was given an immediate transfusion of 550 cubic centimetres of blood.

The patient ran a temperature between 101° and 104°. Her spleen and liver were palpable. A systolic murmur was heard at the apex. X-ray examination of the chest showed an enlarged heart. Wasserman reaction was negative. The Vandenbergh test showed: direct, negative; indirect, 1:125,000.

On discharge (May 26) the hæmoglobin was 41 per cent.; red blood cells, 1,370,000; white blood cells, 6,300; platelets, 260,000.

Readmission.—August 16, 1928; discharged January 17, 1929.

The day before her readmission the patient had a profuse hæmorrhage, and vomited five times thereafter. The liver was felt two and one-half finger-breadths below the ribs. The spleen was not palpable. Her hæmoglobin was 38 per cent.; red blood cells were 3,800,000; white blood cells, 17,500; platelets, 340,000. The following day there was a recurrence of the vomiting.

August 18 she was given a blood transfusion of 425 cubic centimetres of blood (citrate method). Her spleen was now palpable, though it had not been palpable during the hæmorrhages. On September 3, the hæmoglobin had dropped to 27 per cent. She was given another transfusion of 450 cubic centimetres blood (citrate method) on September 4.

September 20.—Her condition was very much improved and the hæmoglobin had risen to 57 per cent. October 8.—another profuse hæmorrhage occurred and the patient vomited forty ounces of blood. The hæmoglobin fell to 35 per cent.

October 11.—Patient had another hæmorrhage, losing twenty ounces of blood. The hæmoglobin fell to 24 per cent. She was given a transfusion of 500 cubic centimetres of blood by the Unger method. October 16.—Another transfusion was given, (600 cubic centimetres) by the Unger method.

Diagnosis.—The medical service made the diagnosis of splenic vein thrombosis and suggested the possibility of ligating the splenic artery. Doctor Lewisohn stated that splenectomy seemed to offer the only chance for a cure in spite of the risk of a major surgical procedure for this debilitated patient.

November 18.—Tarry stools were noted. The hæmoglobin dropped to 16 per cent.

November 25.—The hæmoglobin fell from 60 per cent. to 24 per cent. and the patient was given another transfusion by the citrate method of 500 cubic centimetres of blood.

December 11.—The patient's hæmoglobin rose to 62 per cent.

December 13.—Splenectomy under spinal anæsthesia was carried out through a four-inch subcostal incision. The spleen was about three times normal size. The spleen was delivered, the pedicle was divided. No drainage was used. A small accessory spleen was left *in situ*. The specimen showed: phlebosclerosis of splenic vein; ramifications sinus hyperplasia; reticulum cell proliferation with giant cell formation.

Post-operative course.—The patient made an uneventful recovery except for a subcutaneous abscess. January 5, 1929, her hæmoglobin was 70 per cent.; platelets, 950,000; red blood cells, 4,200,000. She was discharged January 17, 1929.

April 24, 1929.—The patient's hæmoglobin is 79 per cent.; her condition is excellent.

April 18, 1930.—Blood examination shows a marked anæmia: hæmoglobin, 35 per cent.; red blood cells, 2,600,000; white blood cells, 11,200; platelets, 670,000. This patient is not cured, though the hæmorrhages have stopped.

Dr. Nathan Rosenthal (by invitation) said that thrombophlebitic splenomegaly belongs to a heterogenous group known as splenic anæmia or Banti's Disease, although in the latter condition gastric hæmorrhages occur as a late manifestation from cirrhosis of the liver. Twenty-three cases of splenic anæmia have so far been observed at the Mount Sinai Hospital. They can be further subdivided into well-defined groups:

1. *Cirrhosis of the liver with secondary splenomegaly.*—gastric hæmorrhages as a result of cirrhosis of the liver are due to portal obstruction.

2. *Thrombosis of the portal vein* especially in children secondary to infection of the umbilicus can also result in secondary splenomegaly. Gastric hæmorrhages may also occur.

3. *Thrombosis of the splenic vein.*—some of these cases may have gastric hæmorrhages, although in a few cases recently observed, hæmorrhages have been absent and the condition was found accidentally at autopsy.

4. *Thrombophlebitis of the splenic vein.*—Wallgren and others believe that the lesions in the splenic veins are responsible for most of the cases showing splenomegaly. Congestion in the gastric and œsophageal veins results from the obstruction in the splenic vein and is the main factor in causing hæmorrhages from the stomach.

5. A group in which the disease is primary in the spleen and all other manifestations may be considered secondary. This is the most important group under consideration and sometimes the changes of the blood picture were found to be very important in differentiating it from another group, especially before the operation. The blood picture shows a secondary anæmia and leucopenia and a marked diminution of the blood platelets. Such cases appear to be closely related to thrombocytopenic purpura, and splenectomy has proven favorable.

The second group, the thrombocythemic group, usually shows a similar blood picture except that the number of blood platelets are normal. Splenectomy has not been followed by good results. Thrombosis occurs after splenectomy and secondary anæmia may persist. These patients either succumb immediately after the operation, or within five days from thromboses in the portal vein and also other veins.

A pre-operative study of the first case presented by Doctor Lewisohn showed a definite etiological factor; namely, lues, and the blood picture before the operation showed a very marked thrombocytopenia. Thrombophlebitis was found by the pathologists, with secondary phlebosclerosis in the spleen.

This does not fit into the groups mentioned above and shows the variations in the symptoms and causative relations of this particular condition. The second case possibly belongs to the thrombocythemic group, as the patient had a secondary hæmorrhage following the operation and the persistence of a thrombocythemia. It has been pointed out that the spleen in such cases may possibly be a secondary factor for the regulation of the blood platelets. Removal of this organ promotes the marked increase in the number of blood platelets, which is the cause of the secondary thromboses.

In conclusion, one must emphasize the variations of the blood picture, multiplicity of symptoms, the market variations and histological changes of the spleen and blood vessels, and the unusually high late mortality of cases in this group.

ECHINOCOCCUS CYST OF THE LIVER

Dr. Richard Lewisohn presented a man, thirty-three years old, who was admitted to the Medical Service of Mount Sinai Hospital May 17, 1926, and was discharged May 29, 1926. He had had an appendectomy in 1918 in another hospital. Three years before admission he experienced epigastric pain with sour eructations, lasting several weeks. There was no jaundice. He had been free of symptoms until four months ago, when the attack recurred. Two months later, he had another recurrence and collapsed on the street, following which he was taken to another hospital. He still complains of epigastric pain and distress after eating. He has a well-compensated mitral stenosis. X-ray examination failed to visualize the gall-bladder. The patient was discharged improved.

June 8, 1926.—The patient was readmitted to the Surgical Service of Mount Sinai Hospital, discharged June 29, 1926. X-ray examination gave the same findings: pathologic gall-bladder. On June 12 a cholecystectomy was performed by another surgeon. The gall-bladder was not enlarged, and the wall was not thickened. There were no stones. The common duct was not explored. There was a good deal of bleeding from the liver bed. The patient was given a transfusion of 500 cubic centimetres of citrated blood that evening. He made an uneventful operative recovery.

June 12, 1929.—The patient was again admitted to the Medical Service and discharged July 11, 1929. Several months after his discharge, the patient had recurrent attacks. Jaundice occurred with one attack. He entered another hospital where operation was advised. Physical examination showed percussion tenderness over liver. *Diagnosis.*—Common duct stone or postoperative stricture. He was re-operated upon by another surgeon under spinal anæsthesia July 1. The common duct was not dilated; no stones were found, the adhesions were divided.

July 20, 1929.—The patient was again admitted, and discharged July 21, 1929. Three days after his last discharge he had a recurrence of attacks. *Diagnosis.*—Cholangitis lenta; leucine and tyrosine negative. Eosinophiles 1 per cent.

December 9, 1929.—The patient was admitted again to the Medical Service, and was discharged December 16, 1929. Since his former discharge he had had two attacks with jaundice and clay-colored stools lasting one week. The eosinophiles were 1 per cent. He was given duodenal drainage and discharged after eleven days.

January 21, 1930.—The patient was readmitted, as the result of a violent attack of upper abdominal colic radiating to the right shoulder. Several hours

after admission icterus appeared and the urine contained bile. The liver function test showed a slight degree of liver damage. Eosinophiles 3 per cent. X-ray examination January 23 showed a large echinococcus cyst in the right lobe of the liver. (Fig. 2.)

Further X-rays with marking of the right costal arch and stereoscopic pictures showed that a transdiaphragmatic approach was preferable, as the cyst did not develop beyond the arch. For this reason, masurpialization did not seem possible. February 3 the first stage of the operation was performed. The tenth rib was resected under gas and oxygen anæsthesia. The pleura, which was like tissue paper, was inadvertently entered. The diaphragm was sutured to the opening in the pleura. The diaphragm was not adherent to the liver. The wound was packed. On February 10 the second stage of the operation was carried out and the eleventh rib was resected. The diaphragm was incised; a needle was introduced and turbid fluid was aspirated. Microscopic examination showed typical echinococcus fluid. The cyst was entered and a large amount of pus, containing many daughter cysts, was evacuated. A large tube was introduced. The patient is still draining considerable amounts although the cyst has diminished in size.

FIG. 2.—Echinococcus cyst of the liver.

This patient was admitted to different hospitals seven times and was operated upon twice for suspected calculi, before the proper diagnosis of echinococcus cyst was established.

OPERATIVE STRICTURE OF THE COMMON DUCT; DUODENAL FISTULA

DR. RICHARD LEWISOHN presented a woman, fifty years old, who was admitted to Mount Sinai Hospital January 15, 1930. She entered the hospital with a temperature of 103.6°. She was deeply jaundiced and had the following history:

A cholecystectomy had been performed in April, 1927, at another hospital. This operation had been performed through a transverse incision and a large distended gall-bladder had been found. Cholecystectomy and appendectomy were performed. The surgeon who operated upon her stated that an extensive

hæmorrhage was encountered at the time of operation. He thought that he was dealing with an anomaly of one of the large vessels in this region. Two months after this operation she became markedly jaundiced and had chills and fever. These attacks recurred associated with epigastric pains about every three to four months and lasted about two to four weeks. Six days before her admission she had a similar attack with chills and high fever. This attack subsided during the first three days of her stay in this hospital and her jaundice cleared up.

The pre-operative diagnosis was stenosis of the common duct, probably due to traumatic injury. She was kept in this hospital about five weeks, during which time she gained seven pounds. There was some question as to the advisability of surgical intervention in view of the fact that her symptoms had subsided. However, the patient felt she could not be cured in any other way. A liver function test (Doctor Rosenthal) showed retention 35 per cent. and icterus index 30, indicating marked liver impairment.

Operation.—February 22, 1930. Under spinal anæsthesia between the first and second lumber vertebræ a six-inch Bevan incision was made. The peritoneum was easily entered. There were dense adhesions between the omentum and the abdominal wall at the site of the transverse incision. These adhesions were divided. It was very difficult to expose the common duct, as the duodenum was pulled up to the porta hepatis. The duodenum appeared markedly thickened. In freeing the duodenum the lumen of the gut was accidentally entered. This opening was closed in two layers. The part of the duodenum which was involved in this dissection appeared very hard, so much so that there was some doubt as to whether they were dealing with a primary ulcer of the duodenum. There was a large gland at the lower end of the common duct. After this dissection the common duct was well exposed, was not dilated and presented a thin wall. The common duct was entered and a probe was put up towards the liver. About one and one-half inches above the opening into the common duct, a thickened mass was felt, right at the porta hepatis. Whether this stricture was due to inflammatory reaction from without or to an injury of the common duct where it meets the hepatic duct could not be determined definitely. Though a fine probe went through this stricture, it was impossible to dilate it. The condition of the patient and the high location of this mass did not allow a hepatico-duodenostomy. A tube was put into the common duct leading up into the stricture. The opening in the common duct was closed. Two pieces of rubber dam were put around the tube and the wound was closed in layers.

The patient rallied very well from this operation under intravenous glucose infusion and drained well through the common duct. Two days after the operation there was a considerable discharge through the wound and carmine, given by mouth, appeared on the dressing. It was evident that they were dealing with a duodenal fistula. Chemical examination proved further the presence in the discharges of duodenal contents. An immediate jejunostomy (Witzel type) was performed under local anæsthesia and a catheter was introduced into the lower part of the previous operative field. This was connected with a suction apparatus (Fig. 3) and the skin was protected with zinc oxide ointment and talcum powder. Drainage into the suction apparatus was very profuse. She drained between twenty-eight and seventy-seven ounces per day. (Fig. 4.) The drained fluids were immediately reintroduced through the jejunostomy tube. The drainage stopped after two weeks (March 6). The bile, drained through the common duct tube, was reintroduced in the same way through the jejunostomy tube. The common duct tube was removed February 28. The jejunostomy tube was kept in place even after the duodenal

drainage had stopped, as the patient began to hiccough considerably. This hiccough sometimes lasted for twelve hours at a time and could not be controlled by CO_2 inhalations. The white blood cells were 26,000, polymorphonuclears 82 per cent. March 9 the patient began to vomit. As a subphrenic abscess was suspected the subphrenic space was aspirated with negative results. March 11 there was renewed vomiting. A stomach tube was passed and 16 ounces obtained. On the same day a citrate transfusion was given by the drop method through the glucose intravenous apparatus. March 14 her condition improved materially. She took forty-six ounces by mouth without vomiting or hiccough. Vandenbergh was normal. March 18 the jejunostomy tube was removed. The opening in the jejunum closed up immediately. There was no drainage from the site of the jejunostomy tube. From that time on her condition improved rapidly, and she left the hospital April 10, 1930.

It is generally agreed that a duodenal fistula is one of the most serious complications in abdominal surgery. In the attempt to save the life of the patient three problems have to be taken into consideration simultaneously: (1) the

FIG. 3.—Duodenal fistula. A.—Jejunostomy tube. B.—Suction apparatus for duodenal drainage.

DATE		OUNCES
FEBRUARY	23	38
	24	40
	25	77
	26	49
	27	68
	28	63
MARCH	1	40
	2	61
	3	28
	4	28
	5	7
	6	0

FIG. 4.—Table. Drainage from duodenal fistula.

patient has to receive the proper amount of nourishment. This can be accomplished by a jejunostomy. Gastronterostomy with pyloric exclusion does not sidetrack the food completely, as the food can enter the afferent loop and leak out through the fistula.

(2) A complete loss of the pancreatic ferments runs the patient down very rapidly. For this reason, the fluid from the duodenal fistula must be reintroduced into the body through the jejunostomy tube.

(3) The destruction of the structures of the abdominal wall around the fistula is of a fulminating necrotic type and may cause death, unless proper suction is applied.

A case of duodenal fistula, cured by the same method, was presented by Dr. S. Erdman before this Society in 1921.

DR. FRANK S. MATHEWS referred to a patient of his with duodenal fistula following a transduodenal choledochotomy after five days. In addition to prompt use of suction about the fistula, he had attempted to use a duodenal tube inserted by mouth but was unable to get it past the stomach. After a few days a duodenal tube was inserted through the wound into the duodenum and passed

down about ten inches into the jejunum. Through this tube the patient was fed and there was no reflux of the feedings. The fistula finally narrowed down about the tube when mouth feeding began; later the duodenal tube was removed and there was complete healing. By this method of using the tube in the fistula, the patient was spared the operation of jejunostomy.

Dr. John A. McCreery said that there was a patient with this condition on his service at Bellevue hospital last year following operation for ulcer. Doctor Cunningham was able to control the skin digestion by packing the opening in the fistula with raw meat soaked in hydrochloric acid. The result was very satisfactory, but the cure was not nearly as rapid as that accomplished in Doctor Lewisohn's case.

Dr. William F. Cunningham said that in the case referred to by Doctor McCreery he had been advised to use ground beef with hydrochloric acid and shortly after this was put directly over the fistula it closed. They do tend to close spontaneously, but the patients may go downhill so rapidly through loss of fluids that unless jejunostomy or some other form of treatment such as a duodenal tube is used the outcome is disastrous.

RECURRENT CARCINOMA OF SIGMOID, WELL TWO YEARS AFTER SECOND OPERATION

Dr. Richard Lewisohn presented a woman, forty-four years old, who was admitted to Mount Sinai Hospital September 22, 1926. Her husband died at another hospital of carcinoma of the rectum. The patient had had diarrhœa and tenesmus for three years, blood in stool for nine months, sometimes bright red, sometimes dark. Epigastric distress for eight months. A barium enema showed a non-obstructing defect in the sigmoid junction. Sigthrombus produced by a chemical irritant in a vein differs from one occurring the anus. A specimen was removed, microscopic examination of which showed an adenocarcinoma.

Operation, October 6.—A five-inch incision was made and an indurated tumor was discovered in the lower sigmoid. There were no liver metastases. The tumor was removed in typical fashion. An end to end anastomosis was performed. The abdomen was closed with drainage.

Microscopic examination showed an adeno-carcinoma with involvement of the regional lymph-nodes. The patient made an uneventful recovery without leakage and was discharged November 1, 1926.

January 31, 1928.—The patient was readmitted. Since one month, she had had blood in her stool. Sigmoidoscopy showed a recurrence. Microscopic examination of a specimen showed adeno-carcinoma.

February 18, 1928.—A preliminary cæcostomy was performed, which was opened eleven days later. The patient passed a large tapeworm through the cæcostomy opening. On March 26, the recurrent carcinoma of the sigmoid was resected. It was possible to reëstablish the lumen by an end-to-end anastomosis. There was a moderate amount of tension. Microscopic report showed adeno-carcinoma. Following the operation there was a considerable amount of discharge of pus and feculent material. The wound on the left side of the abdomen closed in one month. Closure of the cæcostomy was delayed until May 31 as tapeworms reappeared in the stool. Proper treatment removed

the tapeworm radically. The patient left the hospital on June 20, 1928, and has gained forty pounds since her operation.

Doctor Lewisohn stated that this case presented the following points of interest:

(1) Local recurrence can be attacked with good result, instead of considering these cases as inoperable carcinoma and turning them over to radiotherapeuists for treatment;

(2) A cæcostomy is of great value as a temporary measure for sidetracking the intestinal contents. Cæcostomy not only has a place in obstructive cases, but in a certain group of non-obstructive carcinomata of the large bowel.

THE SURGICAL TREATMENT OF URINARY INCONTINENCE IN WOMEN

DR. MORRIS K. SMITH read a paper with the above title for which see page 394.

DR. FREDERIC W. BANCROFT said he had performed the Kelly operation for partial laceration of the urethral sphincter muscle on five cases. He had used a small Young's prostatic retractor, which was inserted through the urethra and the prongs spread. By traction this indicated the internal meatus. Then, using the pubis as a fulcrum, the prong portion could be pushed outward and an exposure made. A vertical incision over the urethra, with the tractor in position, permitted the exposure of the sphincter muscle and satisfactory suture. All five cases had shown eminently satisfactory results. In the type of case where the woman tends to urinate when she stumbles or sneezes, this operation, which is a simple procedure, gives a great deal of relief.

DR. FRANK S. MATHEWS said that although there are many women who are troubled to some degree with lack of urinary control, Doctor Smith's case was one of unusual severity. In the milder cases, at times, a retroversion pessary will give some degree of relief. He believed that Doctor Smith's success in his case was probably not a little due to the suprapublic cystotomy which would have the effect of giving the sutured wound complete rest.

DOCTOR SMITH, in closing the discussion, said that judging from the literature the Kelly operation has been very successful. In his case, however, it failed. It seemed to him that in cases of severe incontinence, diversion of the urine to give the sutures a better chance to heal was a valuable procedure.

BRIEF COMMUNICATIONS

SODIUM ISO-AMYLETHYL BARBITURATE AND SPINAL ANÆSTHESIA

SPINAL anæsthesia is an exceedingly useful form of anæsthesia, and in the past few years has become a very popular one. But many people dread the prospect of being operated upon in a conscious condition, and for them the experience may be an extreme mental ordeal, which may leave on their mind a most vivid impression of suffering. I refer here to the occasional hypersensitive and unstable individual. This aspect of spinal anæsthesia constitutes a serious drawback.

Preliminary narcosis, as with morphine and scopolamine, or with these and a barbiturate by mouth or rectum, is a great help in such cases; but the effect of such narcosis varies so much with different individuals that the patient cannot with certainty and safety be put definitely asleep. This can, however, be done readily and accurately by the intravenous use of sodium iso-amylethyl barbiturate. As the maximum effect of this drug is thus obtained practically instantly, the desired result can be gauged with considerable accuracy.

The combination of this drug, thus administered, with spinal anæsthesia gives a result which is almost ideal. The patient falls asleep, in her own room, quickly, and without any untoward sensations, and awakens there later, utterly oblivious of her trip to the operating room. At the same time her anæsthesia has been such as to give a maximum of desirable operating conditions, and a minimum of organic toxic effects. Post-operative discomfort is much reduced, because there is minimal nausea and vomiting and because there is a prolonged period of drowsiness with considerable amnesia for unpleasant occurrences.

Of course the ordinary technic for the administration of sodium iso-amylethyl barbiturate must be rigidly adhered to, and due allowance made for the rapid lightening of anæsthesia which takes place for a short time after intravenous administration.

The drop in blood-pressure which usually takes place at this time, and which might make one hesitate about giving spinal anæsthesia, may be practically eliminated by giving twenty-five to fifty milligrams of ephedrin before or with the intravenous injection. Skin sensation is usually retained, so that test is readily made for height of anæsthesia.

The combination of intravenous sodium iso-amylethyl barbiturate and spinal anæsthesia has, in our experience with this method in the clinic, put the patients soundly asleep in a most easy and agreeable manner and given

them an extremely relaxing anæsthesia with a minimum of organic toxic effects and of post-operative discomfort.

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From the Lahey Clinic.

ORTHOPNŒA IN ACUTE RUPTURED TUBAL PREGNANCY

SEVERAL uncommon signs are referred to in the recent literature of ectopic pregnancy. Cullen[1] had reported the occurrence of "bluish discoloration about the umbilicus." Rubin[2] called attention to pain in the shoulders in ruptured ectopic pregnancy—a symptom which he attributed to the irritation of the under-surface of the diaphragm by the extravastated blood. Danforth[3] corroborated this sign in two cases which he recorded. Polak[4] emphasized pain on defecation as a frequent complaint. Though numerous authors discuss the symptoms of shock and dyspnœa in the acute stage of tubal rupture, none mention orthopnœa. Neither Schuman,[5] in his textbook on "Extra-uterine Pregnancy," nor Davis,[6] in his discussion of the subject, lists this symptom. Stein[7] reported 160 cases of extra-uterine pregnancy, Hendry[8] analyzed 152 cases, and Brody[9] fifty cases without mention of orthopnœa.

It is because orthopnœa was an outstanding symptom in a recent case that I have thought it worthy of being reported.

Mrs. I. C., aged twenty years, whose past health was excellent, took sick with cramp-like pains in the lower abdomen. This she attributed to a meal of stale chicken, which food had been held over some seventy-two hours. Directly after eating she experienced intense distress, felt faint, and then became nauseated and vomited. Further inquiry brought out a previously normal gastric record, but menstruation was just a bit irregular. The patient had been one week overdue, and then spotted for a few days prior to the onset of the abdominal symptoms. She was sitting upright in bed, hands pressed against the abdomen, breathing in a shallow manner, lips pale, pulse rapid (about 120°). When asked to lie down she attempted to do so but gasped that lying down made her feel faint. In the moment when she was partly recumbent abdominal rigidity was elicited.

Because a vaginal examination was deemed essential we insisted that she lie down. Again she tried. She was not recumbent more than a moment when she cried, "Please let me up, I can't breathe." During the time that she was lying down the pulse rate increased from 120 to 130 and the expression became wan and anxious. It was imperative that she sit up.

On the basis of a delayed menstruation, the pain and rigidity in the lower abdomen, the striking pallor, the rapid pulse in the absence of fever, and an impression of a fullness in the left adnexa in a hasty vaginal examination, we arrived at a diagnosis of probable ruptured ectopic pregnancy. The presence of the persistent orthopnœa clinched this opinion. So marked was this symptom of "orthopnœa" that the patient felt most comfortable when going to the hospital sitting upright in their automobile.

Laboratory examination showed a white blood cell count of 14,000 and red blood cell count of 4,000.

When laparotomy was done, six hours after the onset of symptoms, the peritoneal cavity was full of blood, estimated at 1,000 to 1,500 cubic centimetres. This was

mopped carefully until the uterus and tubes were seen. The left tube was greatly enlarged and bluish in color. In its center there was a fair-sized, ragged tear—a tubal rupture. A salpingectomy was done. The post-operative recovery was rapid and uneventful. (Pathologist reported tubal pregnancy.)

When the patient awoke from the anæsthesia the orthopnœa was gone and her breathing remained easy throughout the stay at the hospital. When seen several months later her breathing was normal and she gave no history of previous respiratory difficulties.

Comment.—To account for the orthopnœa several explanations are offered:

1. *Orthopnœa Increases Vital Capacity.*—Christie and Beams[10] found that the vital capacity in the erect position or sitting position is greater by about 5.5 per cent. than in the horizontal position. Christie attributes this reduction to interference with the movements of the diaphragm when the patient lies down.

We have no reason to suspect a preëxisting reduced vital capacity in this patient. Her heart and lungs had been normal. There was no history of a previous inflammatory disease of the pleura or chest wall. These are the common causes of reduced vital capacity. Others mentioned by Meyers,[11] such as hyperthyroidism, asthma and emphysema, did not obtain in this case. Of course, profuse hæmorrhage may, by sudden reduction in blood volume, alter the vital capacity.

2. *Orthopnœa May Relieve Pain and Hæmorrhage.*—The patient suffered a great deal of pain. She felt most relieved when she was able to place her hands tightly against the abdomen. It is likely that when she sat erect she could exert such pressure better.

The recumbent position may have favored further bleeding, which the erect position helped to control. It is likely that the mass of blood and the pressure of the arms against the abdomen may have been a force, however slight, to control bleeding.

3. *Upright Position Favored Freer Descent of the Diaphragm.*—A considerable quantity of blood would, in the sitting position, sink into the pelvis, while in the horizontal position a portion might find its way upward towards the diaphragm. This might produce an obstacle not so much by the actual mass of blood, perhaps, as by possible irritation from the blood with an admixture of fetal elements.

4. *Fear.*—Many patients when faced with a feeling of impending dissolution prefer the upright position, for in it they seem to have greater strength and greater confidence.

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Cleveland, Ohio.

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CHEMICAL OBLITERATION OF VARICOSE VEINS

IMPROVED TECHNIC

THE treatment of varicose veins by chemical obliteration has been in vogue sporadically for seventy-five years, and each time has fallen into disrepute because the technic has been faulty or the solutions advised have been dangerous. To become popular, any method of treatment must be simple enough for the average physician to use, must be free from danger,

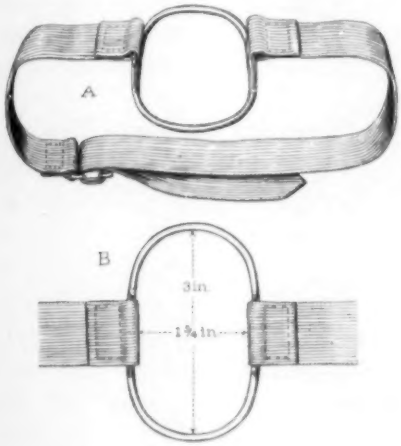

FIG. 1.—Varicose vein occluder.

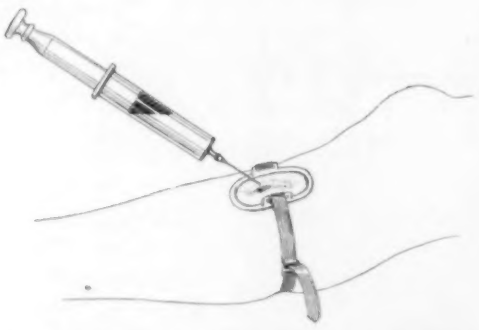

FIG. 2.—Illustrating the technique of injection with sugar solutions.

and still be effective in a large percentage of cases. "Injection treatment" of varicose veins, which should properly be called chemical obliteration, has not been generally adopted because of the supposed dangers of pulmonary embolism, and the dangers of either general reactions or local sloughs due to ill-advised solutions.

When emboli from the large veins are feared after every operation, it hardly seems logical deliberately to produce a thrombus in a vein. However, there is sufficient experimental and clinical evidence to prove that the

thrombus produced by a chemical irritant in a vein differs from one occurring in a patient confined to bed. The first is attached to the vein wall by fibrin and later by fibrous tissue, and is not easily dislodged; the latter forms in a normal vein as a result, primarily, of circulatory stagnation, and is easily loosed when the intravascular tension is raised. The fact that few cases of pulmonary embolism have been reported in many thousands of injections further suggests that the probability of its occurring has been overestimated.

Many solutions, while very effective, have brought discredit upon this method of treatment because of the possibility of their producing a systemic reaction or a local slough. In spite of the greatest care and skill, the solution will occasionally be injected into the tissues outside of the vein, or may leak out of the vein into the subcutaneous tissue after the needle is withdrawn. A slough will follow when caustic solutions such as 30 per cent. sodium salicylate, 30 per cent. sodium chloride, or quinine and urethane are used.

All the requirements for a safe and effective chemical are met in the sugar solutions, glucose and invert sugar. These will not produce a general reaction, and injection into the tissues will not produce necrosis. In the free dispensary work, where cost is an important item, I use 60 per cent. glucose prepared and sterilized in fifty-cubic centimetre flasks sealed with wax paper and gauze. In private work I use invert sugar in 60 per cent. and 70 per cent. concentrations. Sugar solutions are not caustic, and for this reason must be kept in contact with the endothelial lining of the vein for a longer period than any of the violent irritants to produce the necessary inflammation for a subsequent thrombosis. This is most satisfactorily accomplished by using a vein occluder (illustrated in Fig. 1). This is a modification of one described by Theis in the J. A. M. A., November 2, 1929. The steel ring is only four millimetres in diameter, so that, when applied to a segment of vein it will occlude without flattening the vein and rendering it invisible. The side arms with the attached elastic straps are two centimetres high, and are not in the way of the operator.

Technic.—The patient is seated on a chair, and rests her foot on a low stool. The leg is slightly dependent so that the veins are easily visible. The occluder is applied over the vein chosen for treatment, and the elastic strap drawn snugly enough to occlude the segment completely. I use ten- and twenty-cubic centimetre luer syringes and twenty-two- to twenty-five-gauge needles. The desired amount of glucose is drawn into the syringe, and the needle inserted into the vein. With the syringe elevated to about 45° above the horizontal, the blood is withdrawn. Being lighter than the solution, the blood flows through the latter without mixing and forms a supernatant layer in the syringe (Fig. 2). After the blood has been aspirated, five to ten cubic centimetres of the solution, depending upon the size of the vein, are injected. Thus, in one operation, the blood is removed and the glucose injected. The needle is then withdrawn, and the patient asked to hold an alcohol sponge over the puncture wound. The occluder is left in position for at least five minutes to hold the glucose in contact with the endothelium long enough to insure the proper degree of inflammation. After it is removed a gauze pad is fastened over the site of injection with adhesive straps drawn tightly

enough to compress the vein. This pad is left on at least four days to produce a flat, invisible, rather than a round, unsightly thrombus.

With this technic no assistant is needed, chances of infection are minimized, and the blood can be removed without any complicated apparatus. By using a number of occluders, injections can be made in rapid succession without loss of time.

In all cases with large varicosities of the long saphenous above the knee I have preceded injections by ligation of the vein at its highest point of dilatation. This has been done for two reasons: First, as a safety measure. Occasionally thrombosis extends proximally from the point of injection. Such thrombi are not attached to the vein wall by inflammatory products, and the possibility of their becoming loose as emboli exists. Second, by preliminary ligation the column of blood is shut off, making subsequent injections more effective. Pressure of blood on the thrombi produced in the vein below is removed, and canalization and recurrence is prevented. This minor operation is easily done under local anæsthesia. A small transverse incision is made, the vein doubly ligated and cut, and the wound closed with a few interrupted silk stitches. A pressure bandage is applied with adhesive tape, and the patient sent home with instructions to continue regular duties. Embolism is less apt to occur in the ambulatory than in the bed patient. There have been no infections and no complications in thirty-four ligations performed since this work was begun in November, 1928. One week after ligation, when it is certain that normal healing is occurring, injections are begun. Usually one injection of 60 per cent. sugar solution below the point of ligation will completely and permanently obliterate the greater portion of the varix.

Because of the ease with which chemical obliteration can be accomplished after simple ligation, and the permanency of such obliteration, I now ligate before injection all large varices in the calf or the popliteal space as well as those above the knee.

CONCLUSIONS

1. Chemical obliteration of small and moderately sized varicose veins can readily be accomplished by means of harmless sugar solutions held in the vein by a simple vein occluder.

2. Large varices have been most satisfactorily treated by a combination of ligation and injection.

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THE TRANSPLEURAL OPERATION FOR SUBPHRENIC ABSCESS

A SECONDARY abscess beneath the diaphragm develops in approximately .6 per cent. of all cases of suppurative appendicitis. It may develop following rupture of a peptic ulcer, gall-bladder infection, or other suppurative lesions of the abdomen. If the abscess develops in the loin or anteriorly in the subhepatic region, the diagnosis is usually made with ease, and its operative approach and drainage can be readily accomplished.

More frequently it is situated on the upper or posterior surface of the liver, where it is protected by the overlapping ribs, and for this reason its

diagnosis is more baffling and the operative approach more arduous. In such cases the condition may be determined only by the history, the presence of a high, fixed diaphragm, and by the exclusion elsewhere of the presence of pus. The surgical problem is to drain the pus by the most direct route without spreading the infection into the pleural space and into the abdominal cavity. This can best be accomplished by a transpleural operation done in two stages. In the first stage the costo-phrenic angle of the pleura is obliterated and in the second stage the diaphragm is incised and the abscess directly reached.

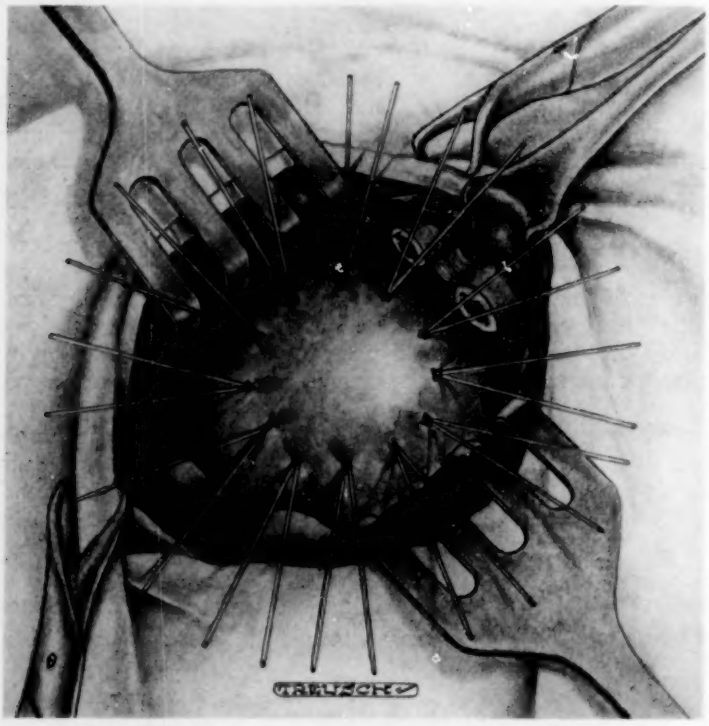

FIG. 1.—First stage. Sutures have been passed through the diaphragm and pleura to obliterate a portion of the costophrenic angle. Sutures are left long to serve as guides at the second stage.

The steps of the operation are as follows: Under procaine, or nitrous oxide and oxygen anæsthesia, about two inches of the eighth and ninth ribs in the posterior axillary line are subperiostially excised. The intercostal vessels, nerves and muscles are removed so as to give a clear view of the underlying pleura. The wound is widely retracted, and through the parietal pleura the lung can be seen moving with each respiration. Below the lung the diaphragm, covered by a diaphragmatic pleura, can be seen. The lung is pushed upward and held by a warm gauze pack and the parietal pleura united to the diaphragmatic pleura with eight or ten interrupted sutures of catgut placed in a circle (Fig. 1). The stitches are placed deeply so as to include the diaphragm, and the ends are left long so as to be used as retraction sutures

at the second stage of the operation (Fig. 2). In order to cause firmer adhesions and a safer obliteration of the costo-phrenic angle, the wound is packed with gauze. Forty-eight hours later the gauze is removed. The pleural surfaces will then be adherent. The sutures, previously placed, are used for traction and a large needle can be passed through the diaphragm into the subphrenic space, or an incision imediately made and the space explored with the finger. If pus is not immediately encountered on the top of the liver, this area should be packed off with gauze and the posterior surface of the liver explored with the finger. When the abscess cavity is encountered it should be drained without further exploration or else the protective barrier of the

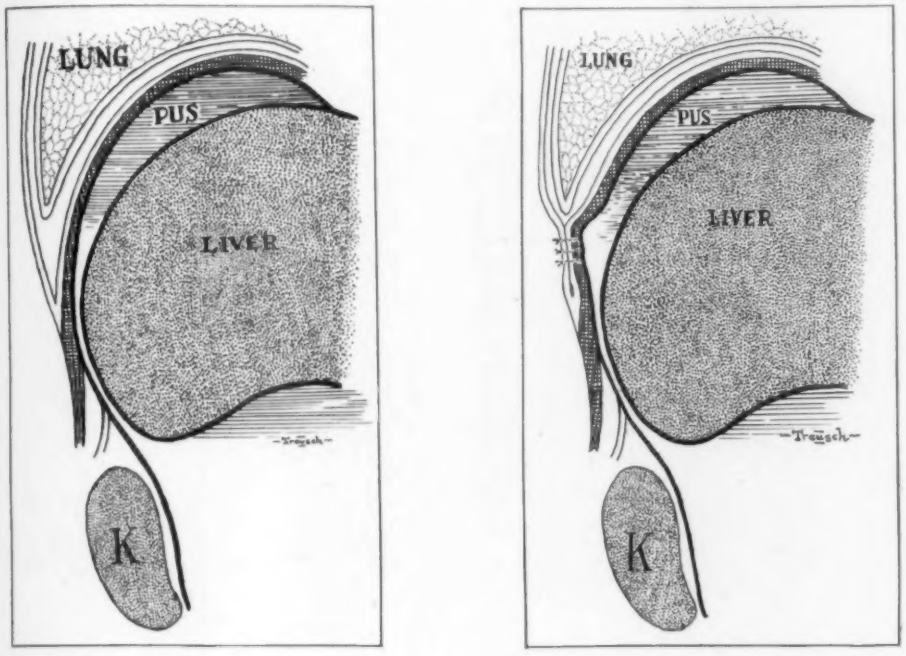

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FIG. 2.—(a) This shows the position of the pus in a high subphrenic abscess. (b) The costo-phrenic angle has been obliterated by the sutures. (Modified from Nather and Ochsner.)

abscess wall may be ruptured and the infection spread. Two large rubber tubes are placed in the bottom of the cavity and into each a catheter is placed for irrigation. Walling-off gauze is left in place for forty-eight hours and at this time hourly irrigations with saline solution or surgical solution of chlorinated soda is begun. The drains are removed at the end of a week and smaller, shorter ones substituted. The gradual shortening of the drains, rather than their early removal, will obviate the danger of a recurrence of the abscess and will insure healing and obliteration of the cavity at its deepest point.

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BOOK REVIEWS

DISEASES OF NOSE, THROAT AND EAR, MEDICAL AND SURGICAL. By WILLIAM LINCOLN BALLENGER, M.D. Cloth; octavo; pp. 1138. Lea and Febiger, Philadelphia, 1930.

In this sixth edition, the author has most painstakingly brought the work up-to-date. The section devoted to the ear is now presented first and in addition to the sound presentation of the anatomy and physiology of the ear, many modern advances have been included. The description in the use of the audiometer, in particular, is well done, as are also the tests for simulated deafness.

The remaining work on the ear is basically sound and is made most lucid by excellent diagrams. This is particularly true with regard to the entire subject of the labyrinth. A most valuable addition to this volume is a large section devoted to peroral endoscopy. This is presented by Drs. Gabriel Tucker and C. L. Jackson, of Philadelphia.

The reviewer feels that this book is one of the most valuable in the entire bibliography of otolaryngology.

HENRY G. BULLWINKEL, M.D.

BURNS. TYPES, PATHOLOGY *and* MANAGEMENT. By GEORGE T. PACK, B.S., M.D., and A. HOBSON DAVIS, B.S., M.D. 8vo Cloth; pp. 364.

What is a BURN? According to the authors: "A burn is an injury inflicted on the body by a degree of heat higher than is compatible with healthy action in the part affected." This seems a comprehensive and quite simple definition, but in the same paragraph we find coupled with dermatitis *combustionis* dermatitis *congelationis,* the effects of absence of heat! Which shows the difficulty in attempts at classification. The work is nevertheless a timely and somewhat exhaustive discussion, the scope of which is well outlined on its title page. We notice with interest that separate chapters are given to Burns by Electricity, Burns by Lightning, Burns by Röntgen Rays, Burns by Radium, Sun Burns, Burns by Caustic Chemicals, and Burns by War Gases. The authors have compressed much valuable material between the pages of this book and it is presented in a clear and well systematized manner that will make reference to it facile. The subject so common and minor to the ordinary standard is one that really deserves more consideration than the surgical student is apt to give it. Such a book is really timely and important even in this day of transcendental surgery.

LEWIS S. PILCHER.

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